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ERRATA.

Page 72, line 1. *For* " The Drought of 1922 " *read* " The Drought of 1921."
„ 80, lines 11 and 12. *For* " Mr. R. S. Sargeant " *read* " Mr. R. Sargeant."
„ 80, line 16. *For* " Dr. R. S. Scott " *read* " Dr. R. H. Scott."
„ 193, line 21. *For* " Dr. E. Fontseri " *read* " Dr. E. Fontseré."
„ 251, line 27. *For* " 2 miles " *read* " 21 miles."
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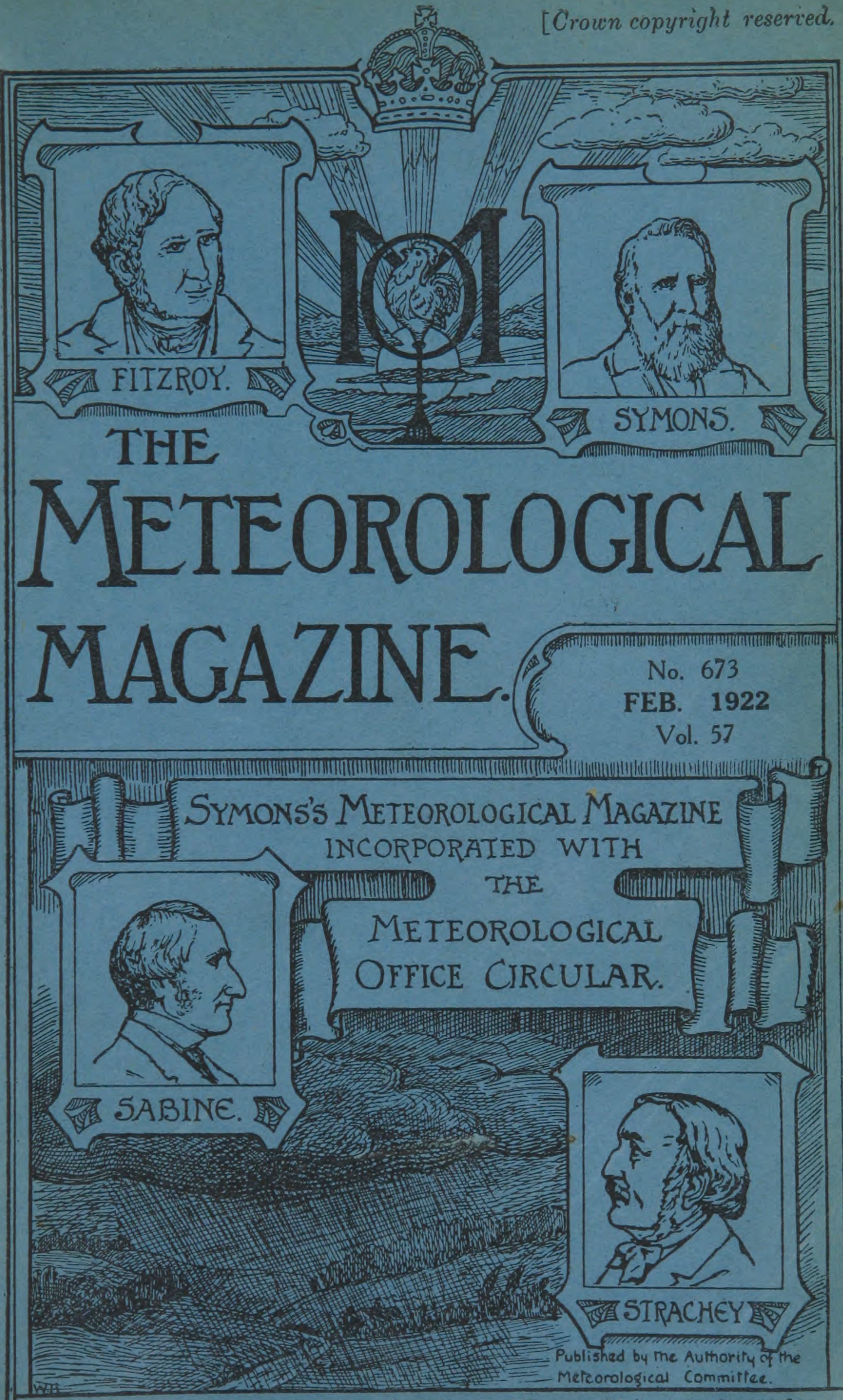

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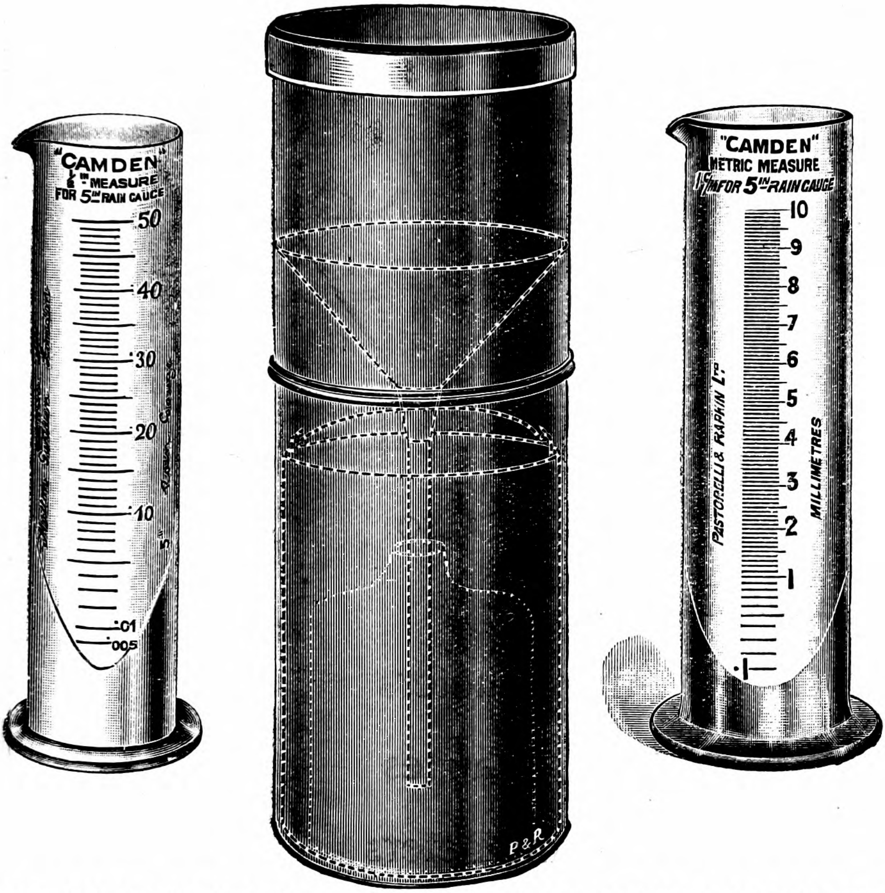
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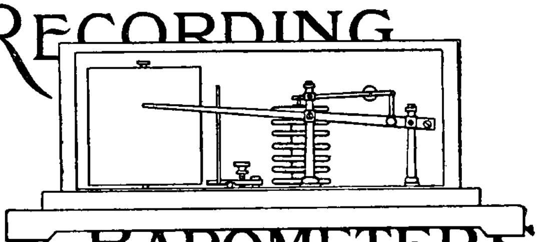

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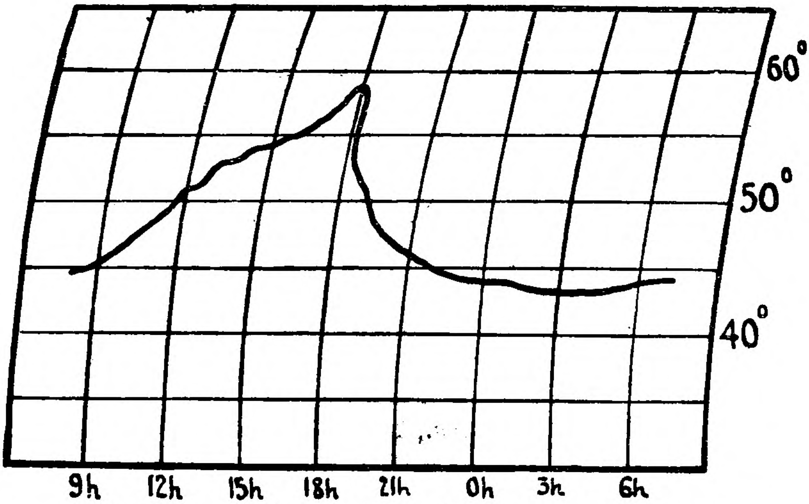
A Sudden Fall in Temperature: Ross-on-Wye, November 2nd, 1921.

By Miss L. F. Lewis.

On November 2nd at about 6.10 p.m., the thermogram at Ross-on-Wye (*see* Fig. 1) showed a remarkable fall of temperature. During the day the temperature rose steadily until 6 p.m., when the maximum, 59° F., occurred. A quite light, northerly wind then set in and in about 10 minutes the drop of temperature could be distinctly felt; by 6.30 p.m. the reading was only 53° F. and by 9 p.m. 46° F.

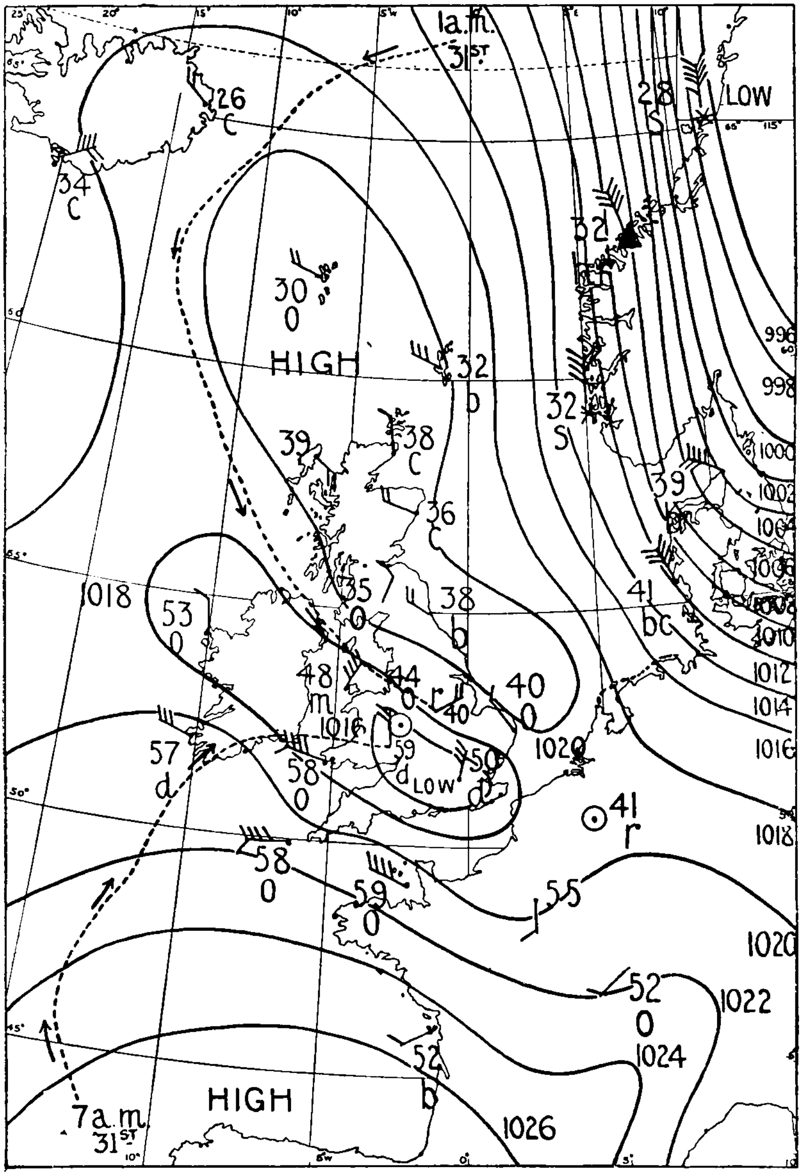
Fig. 1.



Thermogram, Ross-on-Wye, November 2nd, 1921.

As can be seen from the 7 a.m. chart for that day there was a very marked difference in temperature south-west and north-east of a line drawn across the country from Blacksod Point to Folkestone and this difference persisted during the greater part of the day. It is still shown in the 6 p.m. chart here reproduced (Fig. 2), when the temperature at Ross was 19° above that at Nottingham.

FIG. 2.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0°
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15°

SYNOPTIC CHART, 18H., NOVEMBER 2ND, 1921.

Upper air temperature observations taken at Leuchars in East Scotland indicate that temperature up to 6,000 feet was well below the normal. At about 2,000 feet there was a deviation from the normal of –11° F. at 7.30 a.m. and of –7° F. at 3.30 p.m. This shows that there was a solid current of cold air and that the cold air in the north was not merely a surface effect due to radiation.

In the diagram the two pecked lines are the trajectories* (geostrophic) of the air which reached Ross and Nottingham on the morning of that day. They suffice to explain how the sharp contrast of temperature arose which enabled the very light breezes of the shallow depression indicated on the map to cause a very great change of temperature in quite a short time. The air over Ross during the afternoon had come from the warm Atlantic a little north-westward of the coast of Portugal, while that at Nottingham had its source in cold, Arctic regions. It was evidently the replacement of the warm air at Ross by this cold air which caused the sudden fall in temperature. Observations at Malvern, a little less than 20 miles north-east of Ross, show that the cold air had reached that station by 5 p.m., the temperature being only 44° F., consequently the isotherms must have been exceptionally close together at about that time.

The incident is interesting in that it illustrates to what extent the temperature of air can depend upon its past movements, and also how the temperature changes characteristic of a line squall can be brought about without a line squall actually occurring.

Rhythmic Changes in Air Movement.

THE diagram which is reproduced on the following page is an excellent illustration of rhythmic changes in air movement. It has been constructed by copying the records made by autographic instruments at Southport on January 11th, 1907. The pressure curve has been drawn with twice the original vertical scale, the others are direct tracings. The instruments utilised are the Dines Pressure-tube anemograph, the Baxendell Direction-recorder, the Dines Float-barograph and the Dines Thermograph; the two wind-recorders are

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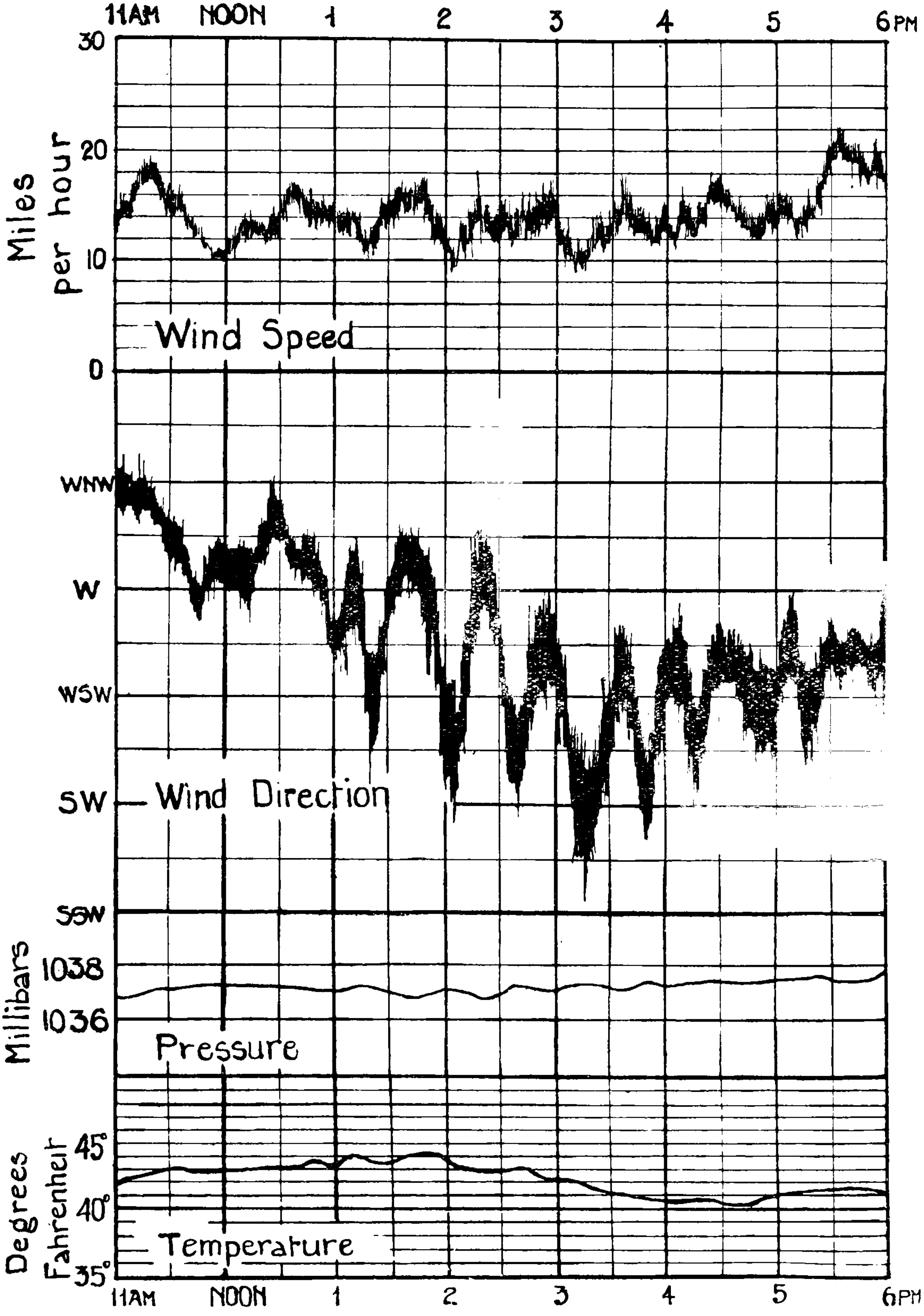
* The geostrophic trajectories, *i.e.*, the paths of the air at about 1,500 feet, were found by tracing the air back in 6-hour periods along the isobars of successive working charts. The geostrophic velocity, V, of the air is calculated from the pressure gradient, γ, by the formula $\gamma = 2\omega V\rho \sin\lambda$, where $\rho =$ air density, $\omega =$ angular velocity of the earth's rotation, and $\lambda =$ latitude. In drawing the trajectories the air motion for each 6-hour period was taken as along the isobars for the end of the period.

For a detailed account of the method of drawing trajectories reference should be made to Shaw and Lempfert: *Life History of Surface Air Currents: A Study of the Surface Trajectories of Moving Air.* M.O. No. 174. An example of geostrophic trajectories may be found in Geddes: *Meteorology*, p. 211.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4
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Miles per hour
Wind Speed
WNW
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Wind Direction
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1036
Pressure
Degrees Fahrenheit
45°
40°
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Temperature
11AM
NOON
1
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6PM

at Marshside, the other two instruments at the Fernley Observatory about a mile to the south. Attention may be called to the advantage of the very open scale of the direction-recorder. In reference to such oscillations as are shown in this diagram Mr. Joseph Baxendell has communicated the following note :—

" I should like to put on record the following facts regarding these rhythmic changes of wind over the exceptionally level and open coastal district of Marshside, Southport :—

1. I doubt if they ever occur unaccompanied by a train of air-pressure waves, but the latter may not, always, at the same time, have the same period as the wind oscillations. Very generally, however, they have. In cases of difference, *e.g.*, when the period is altering during a series, air-pressure *precedes* wind.

2. Air-pressure waves of these rhythmic types frequently occur without any corresponding oscillations of wind.

3. The wind waves sometimes appear, in definitely symmetrical form, in wind speed only, sometimes in direction only, but often in both. When so in one of these elements only, there may even be no trace of any in the other element. But I think the air-pressure waves always appear. The state of the atmosphere, as regards cloud, haze, and visibility, seems to be quite immaterial.

4. They may occur in wind from any direction whatsoever. West, however, produces the finest examples.

5. Almost all of them arise in anticyclonic protuberances.

6. Near the north-western quadrants of large cyclones moving eastwards, they merge, almost insensibly, into hail-squalls. There is other evidence tending to indicate that they are more probably approximately circular whirls or eddies, than cases of wave-motion. Yet it is difficult to reconcile their sometimes beautiful symmetry of succession, with this hypothesis.

7. They occur much more frequently in some years than in others. Long intervals may elapse without any. Local diurnal winds completely destroy, or mask, them; hence they are rarely recorded in summer, except during the night, or on very cloudy days."

The Royal Meteorological Society.

THE Annual General Meeting of the Society was held on January 18th, at 49, Cromwell Road, South Kensington, Mr. R. H. Hooker, M.A., F.S.S., President, in the chair.

The Report of the Council for 1921 was read and adopted and the Symons Gold Medal, which is awarded biennially for distinguished work in connection with Meteorological Science, was presented to Col. H. G. Lyons, F.R.S. In making the presentation, the President laid stress on the importance of Col. Lyons's organisation of the Egyptian Meteorological Service and on his researches in the climatology of the Mediterranean Basin.

The Council for 1922 was duly elected, the new President being Dr. Charles Chree, F.R.S. The retiring President, Mr. R. H. Hooker, delivered an Address on "The Weather and the Crops in Eastern England, 1885–1921."

The object of this address was two-fold: firstly, to determine by the method of correlation, on the basis of the 35 years 1885–1919, which were the critical periods in the growth of the farm crops; and, secondly, to ascertain how far each such period was responsible for the actual crops harvested in each year. Mr. Hooker showed how wheat was most seriously affected by wet weather at sowing in autumn and winter; while warmth in winter was beneficial. The chief requirement of barley was a cool, dry, early summer, whereas for oats the same period should be wet and cool. Turnips wanted rain about June, but cool weather was even more important; and for hay the fundamental necessity was rain in the late spring. The author emphasized, however, that a cool summer was more important than rainfall for almost all crops, excepting only hay, and even that was the better for cool weather. The requirements of potatoes were practically the opposite of all other crops. For quality of seed, absence of rain, and in some cases warmth, was desirable. One feature which strongly emerged was that, as regards bulk of corn, the east of England was too wet (except for oats and beans) and too warm. The author then showed how the worst years, particularly 1893 and 1911, had been due to hot, dry summers, and the same feature was the cause of the generally bad crops of 1921; though wheat, which can stand any amount of heat and drought, was in this year a record. As a type of a good, all-round year he selected 1902, characterised by prolonged cool weather throughout the spring and summer, accompanied by rain until June, and followed by dry weather afterwards—exactly the combination most desired. In the east of England 1920 had a cool summer, only partly spoilt by rain in July, and the resultant crops were mostly good; but the rest of England had much worse crops. The fifteen years 1895–1910 constituted on the whole a period of good crops, but in the last seven or eight years, which have been chiefly notable for dry, warm springs, we have had a succession of very unfavourable weather conditions.

Discussions at the Meteorological Office.

Jan. 23rd, 1922. *Some Measurements of Atmospheric Turbulence.* By L. F. Richardson. (Phil. Trans. Roy. Soc., A. Vol. 221, pp. 1–28.) Opener.—Major G. I. Taylor, F.R.S.

MR. RICHARDSON'S researches on turbulence, which had been before the meeting of December 12th, provided ample material for further discussion at the January meeting. In the paper which was under review on this occasion the actual mechanism of turbulence is considered, the object being to compare the rate of transfer of visible material, such as smoke or thistledown, with that for momentum or temperature. The advantage of dealing with the movement of material objects is that the paths of the single individuals can be followed. Mr. Richardson has established the rule that, in turbulent motion which is the same in character at all heights, the average vertical displacement of a particle varies as the square root of the time. This rule is subject to the condition that the time considered must be considerably longer than the average time of rotation of an eddy. A simple deduction is that, allowing for the horizontal movement of the air, the matter which starts from a single spot spreads out in such a way that it lies half inside and half outside a surface which is a paraboloid at a considerable distance from the source, but is conical near the source. Photographs of smoke obtained with a long exposure bear out this theoretical result. Major Taylor, who summarised the paper, pointed out that the argument in one important section of the paper was unfortunately vitiated by two complementary mistakes—[Equation V (3): there should be a minus sign on the left; p. 10, l. 5: the correlation does not vanish].

He also criticised some theoretical deductions from pilot balloon observations (Table 1), which indicate that the drag exerted by wind on the ground is not in the direction of flow of the air, but may be inclined to it at a large angle. Unfortunately, considerations of space had led to the omission of any detailed description of the method by which the results in question had been reached; in the subsequent discussion Mr. Richardson, who admitted the difficulty involved in accepting the results, expressed the opinion that they should stand as a challenge to further investigation.

Feb. 6th, 1922. *Applications of Heat Radiation Measurements to the Problems of the Evaporation from Lakes and the Heat Convection at their Surfaces.* By A. Ångström. (Geographiska Annaler, II., 3, 1920.)

The Evaporation from the Sea. By G. Wüst. (Institut für Meereskunde, Berlin, Oct. 1920.) Opener.—Mr. M. A. Giblett.

DR. ÅNGSTRÖM attacks the problem of determining the evaporation from a large body of water by considering the heat exchange at the surface. The net gain of heat in a given time from radiation and convection is used partly in changing the temperature of the lake and partly in evaporation. If all but one of the quantities involved can be determined, the remaining one can be deduced. Working with data concerning a certain small lake in Sweden, Ångström selects in the first instance occasions when the air is at the same temperature as the water, so that convection is negligible and, by utilising his knowledge of the incoming and outgoing radiation, as well as information concerning the rate at which the temperature of the lake is changing, he obtains an estimate of the rate at which evaporation must have been taking place. Further, by analysing the circumstances when water was warmed by the air and utilising Witting's formula for evaporation, Ångström arrives at a probable value for the rate of loss of heat by convection. He shows that for each degree centigrade in the excess of water-temperature above air-temperature this loss of heat is of the order of ·01 gramcalorie per square centimetre per minute. The rate of gain of heat by the water, when cooler than the air, is much smaller.

Dr. Wüst, relying on measurements made with evaporimeters on ships, discusses the zonal distribution of evaporation. After appropriate reduction, these observations suggest that evaporation is most rapid between the latitudes 10° and 20° north and south, where it amounts to about 1100 mm. in a year. The rate in the cloudy equatorial belt is rather lower. In latitude 55°, about 400 mm. of water evaporate annually. Comparison between these estimates of evaporation and the data available for the rainfall over the oceans indicates that evaporation exceeds precipitation between latitudes 40° N. and 40° S., except at the equator, but outside these limits precipitation is in excess. The difference is highly correlated with the surface salinity. Wüst's results show good agreement with some determinations by Mr. Giblett from different considerations.*

The discussion indicated that, while the results give the order of magnitude of evaporation in various regions, there was considerable doubt as to their finality. An interesting contribution to the discussion was a note, read by Mr. Harwood, from Dr. C. W. B. Normand relating to evaporation from the Arabian Sea during the monsoon.

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* See *Meteorological Magazine*, Jan. 1922, p. 363.

Correspondence.

To the *Editors, Meteorological Magazine.*

Maximum Temperatures on Winter Nights.

A MARKED characteristic of the climate of the British Islands is the liability of the maximum temperature in the twenty-four hours to occur by night in certain types of weather during the period of the winter solstice. When, as so often happens, during the long night in November, December, January, and, perhaps, February, a waft of damp heat from the Atlantic Ocean sends the thermometer suddenly up to near 55° F., this is almost sure to prove the maximum for the twenty-four hours if frosty, polar air begins to creep down over the country during the ensuing day-time, at a season of the year when solar radiation counts for little. I want to suggest that when these cases occur the emphasis should be laid, not on the *absolute rarity* of maxima at night, which is a commonplace, but on the *relative frequency* of night maxima in the depth of winter, because this is really the interesting climatological feature which ought to be portrayed. Statistical evidence bearing on this point may be found in Mr. M. A. Giblett's paper (*M.O. Professional Notes*, No. 22. A Comparison of Minimum Temperatures, &c., 1921) in which it is shown that the month with the greatest frequency of such inversions of the normal diurnal range of temperature is December, as one would expect. Winter-nights between 50° and 60° F. are, of course, warmer than many a night in summer: but such warmth is typically of a damp, stormy character with frost in its wake, as the equatorial current is replaced by polar air. L. C. W. BONACINA.

27, Tanza Road, London, N.W. 3, *17th December* 1921.

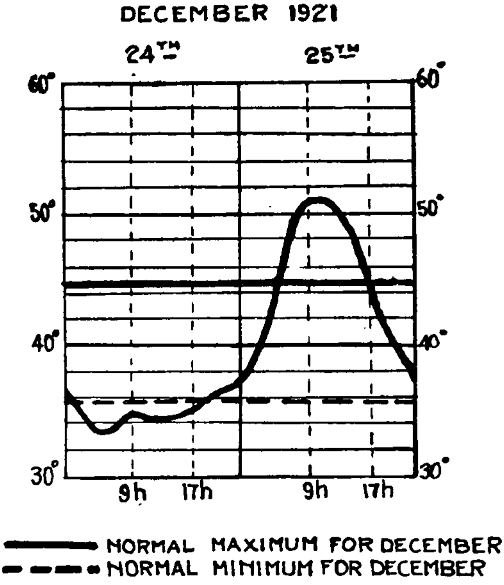
[The question raised by Mr. Bonacina is of special importance in view of the recent introduction of the system of publishing day-maxima and night-minima instead of the extremes for the 24 hours. This system is now adopted in the *Daily Weather Report* for all the telegraphic stations and for the health-resorts. The monthly returns of the observations at the health-resorts are contrived so that the occasions on which the maximum temperature from 9 h. to 9 h. exceeded that from 9 h. to 17 h. may be seen at a glance, as also the occasions on which the minimum temperature for 17 h. to 17 h. was below the minimum for 17 h. to 9 h.

Mr. Bonacina points out that December is the month in which such anomalies are to be expected. In the following table data for December 1921 are set out:—

Station.	Frequency of Occasions during December 1921 with—		Maximum Temperature assigned to December 24th, 1921.	
	Maximum 9 h.-9 h. above Maximum 9 h.-17 h.	Minimum 17 h.-17 h. below Minimum 17 h.-9 h.	9 h.-17 h. Dec. 24th.	9 h.-9 h. Dec. 24th-25th.
Brighton - - - - -	9	5	38	50
Worthing - - - - -	10	1	37	50
Ilfracombe - -	15	2	48	54
Margate	13	0	39	49
Malvern - - - -	10	2	40	46
Tunbridge Wells - -	10	3	36	50

The excess of the numbers in the first column above those in the second is very striking. A partial explanation is that the interval 17 h. to 9 h. is twice as long as that from 9 h. to 17 h., so that in weather such that it is merely a question of luck whether an extreme occurs at one hour rather than another, the chances are 2 to 1 in favour of the night.

The misleading character of the practice of giving the extremes for 24 hours ending 9 h. and "throwing back" the maximum temperature is brought out by the figures for Christmas Eve, which are illustrated by the thermogram for South Kensington here reproduced.



In the south of England the day was cold and the maximum up to midnight was below 40° F. An influx of warm air occurred in the early morning and by 9 h. on Christmas Day temperatures of 50° F. were common.

By the 9 h. to 9 h. system this temperature of 50° F. is credited to December 24th.

The anomaly shows up in the figures reported for London on December 24th ; the maximum temperatures were :—

Greenwich, 50° F. ; Camden Square, 50° F. ; Westminster, 51° F. ; Kew Observatory, 38° F. ; Hampstead, 38° F. The initiated will notice that the interval at the first three stations is 9 h. to 9 h., whilst for Kew it is 7 h. to 18 h. and for Hampstead 21 h. to 21 h.—ED., M.M.]

The Lapse-Rate of Temperature over the Sea.

THE review in the *Meteorological Magazine* of last month, of my paper* on evaporation, contains a criticism that the "dry adiabatic" lapse-rate of temperature (1° C. per 100 m.) employed in an example quoted "is not generally appropriate for air over the sea." This statement does not represent the result of experience, at any rate in sub-tropical and tropical seas, to which the example from my paper, with its sea surface temperature of 75° F., is applicable. As the point is of interest the observational evidence is briefly summarised below.

The aerological results of expeditions prior to and including the cruise of the German ship *Planet* in the Atlantic and Indian Oceans, 1906–1907, are summarised in the *Planet* report, from which the following extract, translated, has been made. After commenting on the agreement with previous results the report proceeds :—

> "In the lowest layers of the atmosphere over the ocean between the tropics and in their neighbourhood, the temperature of the air almost always decreases very rapidly with height : about 1° C. in 100 m. Of the ascents on S.M.S. *Planet* only one showed an average lapse-rate in the lowest half-kilometre as low as 0·5° in 100 m., three gave 0·7°, two 0·8°, eleven 0·9°, four 1·0°, eleven 1·1°, two 1·2° and three even 1·3°. The lapse rate was thus almost as often greater as smaller than the adiabatic rate for dry air."

It will be seen that of 37 observations 31 showed a lapse-rate of at least 0·9° C. per 100 m. An examination of the actual records shows that the steep lapse usually extended up to a level between a half and one kilometre above the surface, where it terminated with an inversion, and also that on these occasions the air temperature near the surface was in general equal to or less than that of the sea surface.

Some Problems connected with Evaporation from Large Expanses of Water. By M. A. Giblett, M.Sc. *Proc. Roy. Soc.* A. Vol. 99, 1921.

These results have been confirmed by simultaneous and subsequent expeditions, in particular those of the *Otaria* (Teisserenc de Bort and Rotch), 1905–1907, that from Lindenberg to East Africa in 1908 and that of the *Möwe* in 1911. Clayton, who summarised the results of the *Otaria* cruise, mentions as his first conclusion " a rapid decrease of temperature with adiabatic gradient from the sea up to a height of some hundreds of metres." The termination of the steep lapse by an inversion was also a feature of these ascents, the height of the inversion being above 500 m. in latitude 35° N. and decreasing towards the equator.

The " dry adiabatic " lapse of temperature is merely a state of neutral equilibrium which is readily established by supplying heat at the surface, as over land on a sunny day, and may even be exceeded so long as the supply is maintained at a sufficiently rapid rate. A body of water, with its large capacity for heat, is very effective in supplying heat to relatively cold air flowing over it, and under such conditions, an adiabatic lapse-rate is probably by no means uncommon in the first half kilometre or so over the sea in any latitude. This would apply particularly to " polar air " flowing southwards and changing its latitude quickly, and the cumulo-nimbus cloud and hail showers which are often observed in it over the sea are evidence of its instability.

High lapse-rates in the first few hundred metres have been observed from a ship by Mr. W. H. Dines at Crinan and by Dr. G. C. Simpson over the North Sea, while the *Planet* report mentions that during a summer cruise in the neighbourhood of Spitzbergen, Prof. Hergesell frequently observed lapse-rates as great as those usual in tropical regions. Thus a " dry adiabatic " lapse of temperature in the lowest layers would be by no means an unreasonable assumption for conditions over the sea in any latitude and is particularly appropriate in the tropics.

M. A. GIBLETT.

West Hampstead, N.W.6, January 30th, 1922.

The End of the Drought?

OUR springs here commenced to run—or, as the local expression is, " created "—last week and many wells now have water in them. This being the case the long drought may be considered over as far as the Thames is concerned. Whether there is any shortage of water in the late summer or autumn will now depend on whether we have good rains in March or April. At present we have daily rain.

CHARLES P. HOOKER.

Cirencester, January 27th, 1922.

Sheet Lightning observed at Sunbury on the night of January 24th–25th.

SHORTLY after 2 a.m. yesterday morning, January 25th, I was aroused by flashes of light coming through my window. On getting up I witnessed a display of sheet lightning quite unusual at this period of the year and probably rarely equalled for brilliance even in the summer months. The flashes, which were at first seen in the north, followed one another in quick succession, lighting up the whole countryside and producing a weird effect. They worked round gradually to the west and then to the south-west. After a short lull, the lightning recommenced in the north and afterwards appeared to come from all directions. The open exposure in all directions from my house enabled me to observe this display to great advantage. When I retired finally about 2.45 a.m. the lightning was still in progress though less brilliant. It is curious that no reports of lightning were received by the Forecast Service of the Meteorological Office. I heard, however, that it was seen between 11 p.m. and midnight in North London.

The lightning was, doubtless, associated with the change in the source of the air supply over this area, which took place about this time, a warm current arriving from the south. At Croydon the thermometer, which had been steady at 26° F. for some time, commenced to rise at 11 p.m. and rose 4·5° in 4 hours. By 7 a.m. a temperature of 33° F. was recorded. The wind, however, continued easterly.

It is interesting to note that reference to a similar phenomenon is made by Dove* as early as 1862. Referring to the storms of January, 1818, he states: "At Dantzic . . . the temperature on the next morning (the 4th) was — 4° with a SSE wind. In the course of the succeeding night, sheet lightning heralded the approach of the equatorial current which came on during the night of the 6th as a S wind, and then shifted through SSW to W, bringing on a thaw." F. ENTWISTLE.

Sunbury-on-Thames, January 26th, 1921.

An unusual Optical Phenomenon.

ON Thursday, January 19th, 1922, occurred a remarkable optical phenomenon which I am at a loss to explain.

After intermittent rain and sleet for most of the day, the sky broke up at about 15h. into ragged fracto-stratus. At

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* *Law of Storms*, Scott's translation, p. 246.

15h. 30m. my brother saw a narrow beam of light extending upwards from the sun, which was near the horizon, nearly to the zenith. There was a mass of fracto-stratus about 15° above the sun, and the beam of light, which was of a reddish colour, passed *under* this, showing that its origin could not have been in ice-crystals in the upper air; indeed no cirrus was visible. The breadth of the beam, whose sides were approximately parallel, was rather less than the apparent diameter of the sun, its luminosity decreased as it rose in the sky, and it was visible in the haze above the horizon nearly down to the sun's upper limb. I saw the phenomenon myself at 16h. 15m. when the top of the beam was only some 20° above the horizon and the sun behind a cloud; it remained visible till 16h. 30m. In the old days it might well have been thought to have some special meaning, since it was followed by a week of the foulest weather, rain, sleet, fog and gloom, it has been my misfortune to record.

R. F. T. GRANGER.

Lenton Fields Climatological Station, Nottingham, January 27th, 1922.

A "Brocken Spectre" on Arthur's Seat.

AT about 11h. 40m. on December 29th, a fine but foggy day, when nearing the top of Arthur's Seat, at Edinburgh, I was interested to see an undoubted Brocken Spectre. I made some gesticulations to make sure that the dim shadow was mine, and these were repeated by the shadow. The haze was so great that everything beyond St. Margaret's Loch (900 yards away) was almost invisible, and the spectre did not seem so far away as this, but I could not make up my mind as to the distance at which I appeared to see it; it might have been about the distance of St. Anthony's Chapel (800 yards). The spectre seemed to be about 100 ft. high. I did not note any rings, coloured or uncoloured.

The phenomenon was best seen when I was standing within a foot or two of the top of the hill, and when I stood on the iron plate that marks the top of the hill the "spectre" became a pillar, but owing to the high wind, I did not repeat the gesticulations.

In the ordinary explanations of the Brocken Spectre, as I have understood them, it is stated to be a shadow *on* a cloud, *i.e.*, the outline of the shadow would be a linear curve in space. But it seemed to me that the effect was a cumulative one, as if it was rather due to seeing lots of cloud particles in shadow, in line with the eye—as if the "shadow" were really not a curve in space but a *surface* in space, a cone with the apex to the observer's eye. Hence it was not easy to tell at what distance the spectre seemed to be. It was somewhere between the point where the opacity of the haze was so great that no light was being reflected to the eye, and a point so near the eye that the difference in luminosity of the particles in sun and shade was not sufficiently marked to be noticeable.

As the result of the experience I feel that I understand the spectre in a way I never could before, when I thought of it as a shadow at a definite distance on a definite object.

With so many motor cars about with powerful lamps, spectres akin to the Brocken should nowadays be one of the commonest of artificial meteorological phenomena, but the sun-formed spectre itself should not be uncommon on eminences near smoky towns.

M. M'CALLUM FAIRGRIEVE.

The Edinburgh Academy, January 23rd, 1922.

Weather Lore.

IN meteorology we are familiar with a number of saws (wise and otherwise) derived from the experience of seamen and landsmen. Some of the adverse criticisms which these saws meet with may be accounted for by the special localities which supplied the experience on which they were founded, just as Hooke's legends on the wheel-barometer are not so suitable for Buxton or for Paris (and I have found them displayed in both places) as they are for London, where Hooke lived. The sayings in Mr. Inwards's collection are for the most part simply chronological not local; I mean that time is the only variable considered.

Coming home from Bergen last summer, the Captain of the *Jupiter* gave me one of a new kind: that the weather always changes in crossing from the Norway Deep to the shallower water. I think I have an explanation of that as part of the general influence of coast lines on weather. Captain Hepworth used to insist that the weather changed with the turn of the tide; neither he nor I could suggest an explanation. A layer of water 20 feet thick has some potential effects, but what they are no one seems to know.

What I write for now is to ask whether any readers of the Magazine, sailors or landsmen, can mention any other weather-maxims representing the effect of special localities. The world over, there must be a good number which have not yet got themselves recorded. NAPIER SHAW.

School of Meteorology, January 17th, 1922.

NOTES AND QUERIES.

A Note on the Meteorological Conditions affecting Scent.

THE following note was prompted by the apparently well-founded opinion that the degree of scent obtained in the hunting field must depend upon the meteorological conditions prevailing at the time of the hunt.

The degree of scent prevailing upon the various days on which hunting took place during the period August 30th, 1920, to March 2nd, 1921, was kindly provided by the members of the Belvoir and the Blankney Hunts, notably by Major T. Bouch, the Master of the Belvoir, and by Squadron Leader A. H. James, R.A.F. Other scent data used were provided by members of the Cranwell R.A.F. Beagles.

Theoretically, on the assumption that scent consists of small material particles reaching the noses of the hounds, it would appear that the meteorological conditions making for good scent would be those which would keep the material particles down to the level of the hounds. These conditions would seem to be :

(*a*) the absence of convection currents of air upwards ;
(*b*) a high relative humidity ; and
(*c*) the absence of wind.

Condition (*a*) would come into play if the temperature on the ground were lower than that at a height of 2 feet, for then there would be no tendency for the lower air to rise, as it would be of greater density than the air at 2 feet. Condition (*b*) might be a condition of good scent if the particles happened to be hygroscopic, for the collection of moisture on them would weigh them down. Condition (*c*), the absence of wind, would operate by eliminating an agent which would dissipate the scent particles over a large area and thus diminish their intensity.

Classification.		Number of Occasions.	Proportion of Good Scents.
			per cent.
All observations - - - - -		53	54
GROUND-FROST on previous night - - -		10	80
TEMPERATURE* at 2 ft. higher than that at ground		36	58
,, ,, lower ,, ,, -		9	22
RELATIVE HUMIDITY	not below 85 per cent. -	30	70
	below 85 per cent. - -	23	50
WIND SPEED at 40 ft.	exceeding 7 m.p.h. -	39	50
	not exceeding 7 m.p.h. -	14	64

* Temperature data were not available on 8 occasions.

The meteorological conditions prevailing upon each hunting day were compared with the degree of scent experienced during the day. The results are shown in the following Table, 53 " scents " being available in all. The temperatures on the ground and at 2 feet were determined as near as may be by fully exposed thermometers.

It would seem, too, that ground-frost just before a hunt should mean good scent inasmuch as it probably connotes that the actual ground is colder than the air at 2 feet, and consequently that no upward currents are set up. This is borne out by the actual results obtained. Ten hunts occurred immediately after ground-frost and eight of these were accompanied by " fair " or better scent.

Due weight must be allowed to the shortness of the period examined, making general results unjustifiable. Granting this, the Table shows that no one meteorological element stands out as accompanied, always, or nearly always, by a high degree of scent. Nevertheless, it seems to be true that a fair or good scent is probable when the following conditions hold :

(*a*) the absence of winds over 7 m.p.h. ;
(*b*) a relative humidity of over 85 per cent. ;
(*c*) the presence of an " inversion of temperature " at ground level; that is the temperature of the ground being lower than that at 2 feet;
(*d*) the presence of a ground-frost.

W. H. PICK.

Climate and Clothing.

AN interesting discussion of "Thermal Sanitation in the Tropics" is given by Mr. G. W. Grabham in the *Journal of Hygiene*, Vol. XIX., No. 3. Mr. Grabham has carried out a number of experiments in Khartoum to test the heat-absorbing properties of various materials and fabrics and has investigated in less detail the translucency and porosity of materials used for clothing. Perhaps the most striking point brought out by the investigation is the great amount of heat absorbed by khaki materials. White drill exposed to the sun has a temperature about 11° C. above that of the air, thin khaki drill 29° C. above, thick khaki drill 33° C. above, black cotton cloth 41° C. above. With regard to porosity and translucency, white calico proves to be by far the most satisfactory material. Khaki may be a useful colour in so far as it is inconspicuous and durable, but it cannot be recommended from a hygienic point of view, and khaki uniform must cause unnecessary discomfort.

The great benefit to be derived from whitewashing walls and roofs is also shown. Whitewash is the ideal "paint," but white oxide paint is nearly as good.

The historical summary given at the end of the paper is interesting, and it is remarkable that Mr. Grabham has been able to consult such a variety of scientific works in the heart of Africa. We notice, however, that Dr. Leonard Hill's reports do not seem to have been available.

Storm Floods.

THE overflowing of the Thames in London in November 1921 and the floods which occurred at Hull in December were due to rises in level in the North Sea under the influence of northerly gales which happened to coincide with spring tides, and provide examples on our own shores of a phenomenon which is frequently observed in varying degrees of intensity in the Baltic Sea. According to the *Segelhandbuch der Ostsee*, published by the "Reichs-Marine-Amt," from which the following information is taken, tides are practically non-existent in the Baltic, and the surface currents nearly always follow the wind direction with a slight deflection to the right owing to the earth's rotation. Alterations in level are, therefore, almost entirely dependent on changes in the wind and are quite perceptible even with light winds, the tendency being to pile up the water on any given part of the coast when the wind comes off the sea and to depress the water level on the coast when the wind is from the land; floods (Sturmfluten) occur when the wind reaches storm force. Storm floods are most frequent in the south-western part of the Baltic, where the dangerous winds are those from east and north-east. In November 1872 the water rose at Lübeck and Wismar during a storm to a height of 3 or 4 metres above its normal level and inundated wide stretches of the coastal districts. Considerable damage was caused to property, and some of the dunes on the sandy coasts of Pomerania and Mecklenburg were almost completely washed away. Similar floods occurred in the years 1625, 1694, and 1784.

Another closely connected phenomenon is the sudden fall in temperature of the water on the Baltic coasts which occurs during the prevalence of a wind off the land. The warm surface water is blown out to sea, tending to cause a depression of the water level on the coast with a consequent upwelling of colder water from below. In the Gulf of Danzig in June 1889 a change in temperature from 70° F. to 46° F. was observed during a light southerly to south-easterly wind, but the temperature rose again after the wind had gone round to north. In this case, however, no appreciable changes in water level were recorded at Neufahrwasser.

J. WADSWORTH.

The Flight of Thistledown.

RECENT numbers of *Nature* contain interesting correspondence on the flight of thistledown. Professor Miles Walker of the College of Technology, Manchester, is of the opinion that fully-blown thistledown in sunshine has a positive lifting power, apart from any general upward current of the air. He suggests that the sun in shining on the fine cilia warms them and creates a small local current of warm air. Mr. W. E. Lishman, of Newcastle-upon-Tyne, cites an instance of the "hovering" of thistledown. On a very hot day with air still except for the quivering from heat, what seemed to be a dragon-fly was observed hovering five or six feet above the ground and frequently darting a foot or two away. The object was found to be a thread of thistledown about an inch in length. No current was noticeable, the movement, or the stationary quivering attitude, seemed to be independent. Mr. L. F. Richardson who has examined the flight of thistledown in his researches in atmospheric turbulence* states that he has frequently observed the rising of plant-down on calm sunny days and suggests that the upward motion is due to upward currents of air since the air is usually full of eddies on a hot afternoon. He also points out that in order to prove that the thistledown moves through and not with the air, it would be necessary to make simultaneous and contiguous measurements of air-motion by means of smoke or some special anemometer.

Prof. James Small, of Queen's University, Belfast, who has made a special study of the hydrodynamics of fruit dispersal† writes that a wind of 1 mile per hour will raise the pappose fruit of the dandelion, *i.e.*, the seed with its parachute, whilst for groundsel and coltsfoot horizontal currents of about $\frac{2}{3}$ mile per hour suffice. Naturally, the pappus alone would be lifted by a still slower current. It is interesting to notice that none of the investigators taking part in this correspondence have found it necessary to invoke the special forces postulated by Dr. Hankin‡ in explanation of the soaring flight of insects.

L'Institut de Physique du Globe.

IN the issue of this Magazine for February 1921, notice was given of the creation of L'Office National Météorologique by the unification of the three French Meteorological Services. This office is responsible for all meteorological questions, but other geophysical subjects, and in particular, terrestrial magnetism, are now dealt with by L'Institut de Physique du Globe. The institute, which is to be closely associated with the University of Paris, is still in process of organization, but the Director, Professor Maurain, hopes to proceed with the publication of magnetic data during the present year. The address, both of the National Office and of the Institute, is 176, *Rue de l'Université, Paris.*

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* *Roy. Soc. Phil. Trans.* A. Vol. 221, 1920, p. 1. *See also* p. 6 *of this issue.*

† *Origin and Development of the Compositae.* Wheldon and Wesley, 1919.

‡ *Meteorological Magazine*, 1921, p. 43.

Meteorology in German Universities.

We learn from *Nachrichten für Luftfahrer* that courses of instruction in aviation have been arranged in many of the German universities and technical colleges. Meteorology, theoretical or practical, occurs in the syllabus of thirteen out of the sixteen institutions mentioned. The list of lecturers includes the names of Kassner, Hellmann, Hergesell, Wiechert, Wenger, Georgii, Peppler and Schmauss.

International Aerological Soundings.

A list of the dates fixed for the international balloon days has been received from the International Commission for the Scientific Investigation of the Upper Air. The dates are given in the following table, which supplements that given on p. 216 of the last volume of this magazine. The dates in heavy type are those on which two ascents daily are to be made.

Year.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
1922	**17–19**				15–20				11–16			
1923		12–17				**12–14**				15–20		
1924			17–22				14–19				**11–13**	
1925				**14–16**				17–22				14–19
1926	11–16				17–22				**14–16**			
1927		**15–17**				13–18				17–22		
1928			12–17				**17–19**				12–17	

The Care of Thermograph Coils.

Enquiries as to the treatment of bimetallic coils of thermographs in order to prevent corrosion are sometimes received at the Meteorological Office. Observers may be interested to know, therefore, that a thermograph, the coil of which was coated with Jenson's air-drying enamel, was brought into use at an out-station in December, 1920. In June, 1921, the observer reported as follows :—" While the condition of the coil of the thermograph is very much better than it would have been without the enamel, there are some traces of rust showing. The use of the enamel has certainly been justified. In my opinion the sensitivity of the thermograph has not been affected to any appreciable extent." Robbialac black enamel is also suitable for the purpose. Before applying the enamel, great care must be taken thoroughly to clean away, as far as possible, all grease and rust which may adhere to the coils, completing the preparation for enamelling by washing with petrol.

The Multi-Scale Thermometer.

THERMOMETERS provided with an ingenious arrangement of six scales have recently been made by Messrs. Negretti and Zambra to the specification of Prof. McAdie, who has very kindly presented a specimen to the Meteorological Office. The observer provided with such a thermometer can read at will the temperature on the Fahrenheit, Centigrade, Absolute or Kelvin-Kilograd scale as well as the saturation vapour-pressure in kilodynes per square centimetre, and the weight of saturated vapour in grams per cubic metre.

Review.

Rainfall in the Southern Pennines, Vol. I. No. 9. *Annual Summary:* 1918. By A. A. Barnes. Size, 9 × 10½ in., pp. 35 + 58; 2 maps.

MR. BARNES'S monthly summaries of the rainfall in the Southern Pennines have not appeared since 1918. We are glad to see that he is now publishing his annual summary for that year.

This pamphlet, though slender in size, is the outcome of a great amount of assiduous labour. The data are mostly arranged in tabular form as in *British Rainfall*, with convenient map references to facilitate locating the stations, and in nearly every case there is added the actual or computed average value for the period 1865–1908, and the percentage of this amount which fell during 1918. This period is selected as giving the closest approximation to the true normal rainfall.* It is to be feared, however, that in many cases faulty rain gauge exposure has vitiated the average values, for the geographical distribution of the percentage values shows some irregularities which would be difficult to explain on any other hypothesis. In spite of this minor defect the two maps showing respectively the distribution of actual rainfall during the year, and that of the fall in its relation to the average are valuable contributions to detailed rainfall mapping. They show clearly that the district under review is one of greatly varying precipitation, and provide a study of the relation between rainfall and the configuration of the land, which is in some respects unique. We heartily congratulate Mr. Barnes and the Manchester and Stockport Rainfall Organization and hope that the publication will be continued on similar lines.

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* See *Q. J. R. Met. Soc.*, Vol. XIV., p. 209.

Obituary.

Sir Ernest Shackleton, C.V.O.—The news of the arrival at South Georgia of the *Quest* carrying the Shackleton-Rowett Antarctic Expedition was being awaited with some anxiety, when a cable from Montevideo announced that she had reached that gateway of the Antarctic seas and that the leader, Sir Ernest Shackleton, had died on January 5th of a heart seizure with appalling suddenness. The *Quest* proceeded on her voyage, as provided in the original plans, under the command of Commander Frank Wild, and the body of the great leader was accompanied to South America by Captain Hussey, the meteorologist of the expedition. It has been arranged that the remains shall be taken again to South Georgia for interment.

The career of Sir Ernest Shackleton as an Antarctic explorer began at the age of 26, when he sailed in Captain Scott's first expedition on the *Discovery* in 1901. Brought up to the sea and fired with the love of adventure, Sir Ernest threw his whole heart into the advance of discovery in the far south. He accompanied Scott on his southern journey on the Great Ice Barrier and, although attacked by serious illness on the return, he struggled on until the base was reached.

He was invalided home before the second winter of the expedition, and in 1904 he became secretary of the Royal Scottish Geographical Society and attained great proficiency as a popular lecturer. In 1907 he set out on an expedition of his own, financed by the guarantees of friends, and free of any external control, with the avowed intention of reaching the South Pole. He relied on new methods of transport and a new dietary, and would have succeeded had not the last of the ponies, on which he depended for food after it was no longer useful for transport, fallen down a crevasse in the Beardmore Glacier. He did succeed in reaching 88° 24′ S. on the great plateau, 10,000 feet above sea-level, and only 97 geographical miles of easy going from the Pole. The scientific results of the expedition were of the utmost value, though the meteorological data have not yet been published in full. We understand that the material, together with that of the following expedition, is now in the hands of Mr. R. C. Mossman for complete discussion.

After Shackleton had collected money enough to pay all the debts of the expedition by lecturing and showing his kinematograph views, for it was he who introduced this form of photography in the Antarctic, he planned a new and more ambitious exploit. He meant to cross the Antarctic continent, but his ship, the *Endurance*, was caught in the ice of the Weddell Sea, and after long drifting was lost. The amazing dash and resourcefulness as a leader of successful advance had not prepared the public for Shackleton's prudence and caution in conducting an almost hopeless retreat; but it was in him to achieve greater fame in retrieving loss than even in following up success. His work was fully noticed in these pages (Vol. 51, 1916, p. 113) at the time: it appears even more magnificent in retrospect. Returning to England in 1917, Shackleton joined the North-Russian expeditionary force, and as soon as the return of peace set him free, and his lectures on the *Endurance* expedition enabled him to pay off its cost, his ever-active brain conceived his last great venture. The event shows that he overestimated the power of an ever-young mind to control a body which, in spite of great strength, had been sorely tried by twenty years of almost superhuman toil and hardship.

He was a man who pioneered the way for scientific research, but he laid his countrymen under a greater debt by his embodiment of the spirit of romantic adventure, showing that it could flourish as gloriously in the twentieth century as in the time of Queen Elizabeth. He won the affection of all he commanded, but he never lost their respect, and those who had gone with him once were always the most eager to follow him again. He was an inspiring leader and a faithful friend whose memory will live with the fame of the greatest discoverers of all time.

H. R. M.

Father Giuseppe Lais, S.J.—The death is announced of Father Giuseppe Lais who had acted as vice-director of the Vatican Observatory since 1903. He was also vice-secretary of the Accademia dei Nuovi Lincei at Rome for many years.

Father Lais was the author of a long series of papers on meteorology, mediæval and modern, astronomy and calendar reform, and he has published some little-known meteorological records of the sixteenth and seventeenth centries.

Professor Robert Wenger, Director of the Geophysical Institute of the University of Leipzig, died on January 20th, 1912. Prof. Wenger, who succeeded Prof. V. Bjerknes as Director of the

Institute, had maintained the high level of its work, and was himself the author of several important papers on Dynamical Meteorology.

News in Brief.

A NEW feature has been introduced in the January number of the monthly fly-sheet issued as the *Supplement to the Daily Weather Report,* a diagram showing the day-maxima and night-minima at Kew Observatory.

MR. F. J. GURNEY, who measures the water drained from farmland at Ridgewell, Essex, where there is a substratum of heavy clay soil, reports that the outflow which had ceased on February 2nd, 1921, recommenced on January 19th, 1922.

Conquest for December 1921 contains a popular illustrated article on "The Exploration of the Upper Air" by Mr. W. G. W. Mitchell of Newbury Grammar School.

ON December 8th Lord Rayleigh read a paper on the "Aurora Line in the Spectrum of the Night Sky" before the Royal Society.

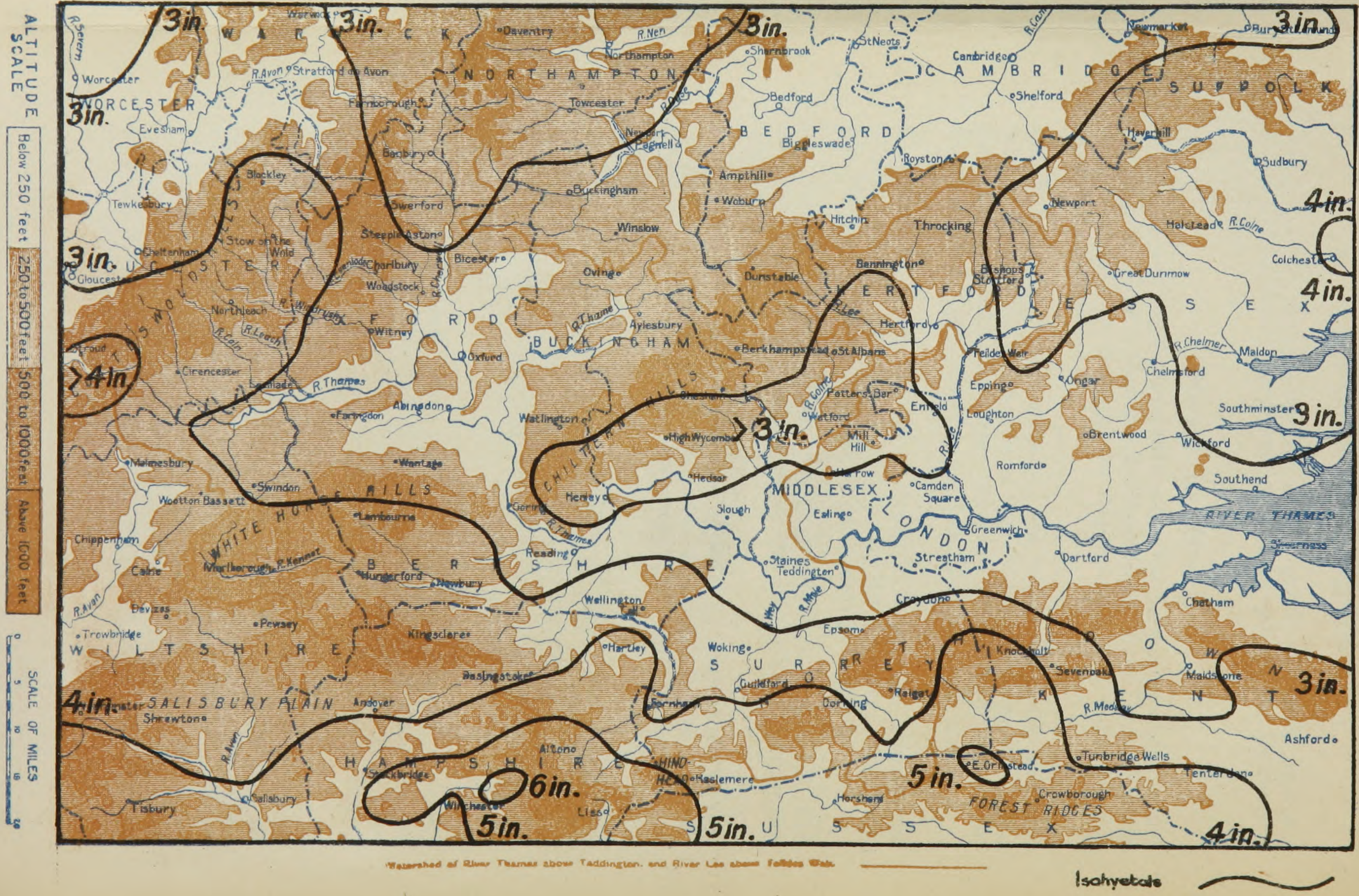
"The Relation of Atmospheric Electrical Variation to the Incidence of Epileptic Fits" was discussed by Dr. A. G. S. Mahomed on December 8th at the Royal Society of Medicine.

At the meeting of the Geographical Association at Birkbeck College on January 6th Miss L. Winchester of Liverpool University read a paper on "Some Climatic Problems of Modern Palestine," the outstanding problem being the seriousness of the summer drought and the adequate storage of water from winter rains.

Meteorological Books.—Mr. James Smith, of Pinewood, Crathes, Aberdeenshire, writes that he wishes to dispose of a number of meteorological books and instruments and would be glad to hear of likely purchasers. Any communications on the subject should be sent direct to Mr. Smith.

A USEFUL calendar has been received from the Pluvius Department of the Eagle, Star and British Dominions Insurance Company. On the front is shown a time-dial, which gives summer time as well as the hours on the 24-hour clock and the 12-hour clock, while tables for the conversion of inches to millimetres and of inches to millibars together with the specification of the Beaufort scale of wind-force are set out on the back.

THAMES VALLEY RAINFALL —— JANUARY, 1922.


ALTITUDE SCALE
Below 250 feet
250 to 500 feet
500 to 1000 feet
Above 1000 feet
SCALE OF MILES
0
5
10
15
20
Watershed of River Thames above Teddington, and River Lee above Feildes Weir.
Isohyetals
3 in.
3 in.
3 in.
3 in.
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3 in.
3 in.
>4 in.
4 in.
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>3 in.
3 in.
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6 in.
5 in.
5 in.
WORCESTER
NORTHAMPTON
BEDFORD
CAMBRIDGE
SUFFOLK
ESSEX
HERTFORD
BUCKINGHAM
OXFORD
GLOUCESTER
WILTSHIRE
BERKSHIRE
MIDDLESEX
LONDON
SURREY
KENT
HAMPSHIRE
SUSSEX
COTSWOLD HILLS
CHILTERN HILLS
WHITE HORSE HILLS
SALISBURY PLAIN
HINDHEAD
FOREST RIDGES
RIVER THAMES
R. Severn
R. Avon
R. Nen
R. Cam
R. Colne
R. Chelmer
R. Lee
R. Thame
R. Thames
R. Windrush
R. Cherwell
R. Leach
R. Coln
R. Kennet
R. Wey
R. Mole
R. Medway
Worcester
Evesham
Tewkesbury
Cheltenham
Gloucester
Stroud
Cirencester
Lechlade
Northleach
Stow on the Wold
Blockley
Warwick
Stratford on Avon
Farnborough
Banbury
Swerford
Steeple Aston
Charlbury
Woodstock
Witney
Bicester
Oxford
Abingdon
Faringdon
Wantage
Swindon
Malmesbury
Wootton Bassett
Chippenham
Calne
Devizes
Trowbridge
Marlborough
Pewsey
Lambourne
Hungerford
Newbury
Kingsclere
Basingstoke
Andover
Shrewton
Stockbridge
Winchester
Salisbury
Tisbury
Alton
Liss
Haslemere
Farnham
Hartley
Wellington College
Reading
Goring
Henley
Hedsor
High Wycombe
Watlington
Wendover
Aylesbury
Oving
Winslow
Buckingham
Towcester
Daventry
Northampton
Newport Pagnell
Ampthill
Woburn
Bedford
Biggleswade
Sharnbrook
St. Neots
Dunstable
Berkhampstead
St. Albans
Hitchin
Royston
Cambridge
Shelford
Newmarket
Bury St. Edmunds
Haverhill
Newport
Throcking
Bennington
Hertford
Bishops Stortford
Great Dunmow
Halstead
Sudbury
Colchester
Chelmsford
Maldon
Southminster
Wickford
Southend
Feildes Weir
Epping
Ongar
Loughton
Brentwood
Romford
Enfield
Watford
Patters Bar
Mill Hill
Harrow
Camden Square
Ealing
Slough
Staines
Teddington
Greenwich
Streatham
Dartford
Croydon
Epsom
Woking
Guildford
Dorking
Reigate
Knockholt
Sevenoaks
Chatham
Sheerness
Maidstone
Ashford
Tenterden
Tunbridge Wells
E. Grinstead
Crowborough
Horsham

H.M.Stationery Office Press, Kingsway, W.C.2.

The Weather of January, 1922.

THE weather of January, 1922, was typically variable. In the British Isles both very low day temperatures and very high day temperatures obtained with greater frequency than usual. Temperature in Scandinavia and the Netherlands has been very low. Rainfall in the British Isles was above normal generally and sunshine approximately normal. The amount of snow and its persistence was distinctly more than normal, especially along the Scots Border, where road traffic was seriously affected. Perhaps the outstanding feature was the prevalence of gales and high winds. On only eight days of the month were gale warnings not flying on some part of the coasts of the British Isles. The loss of shipping and human life was unfortunately very heavy.

The pressure distribution of the first day of the month gave a westerly type of weather. An area of high pressure was centred over Portugal and a depression between Iceland and Norway. The weather was generally overcast and considerable amounts of rain fell over the whole area. Temperature in the British Isles was above normal. By the morning of the 2nd, the depression, moving quickly eastwards, was centred over Scandinavia. The cold north-westerly wind behind this depression caused a great fall in temperature, and snow showers occurred in the north of Scotland. During the 3rd, 4th and 5th, the " high " over Portugal moved out over the Atlantic in a north-westerly direction, while the Scandinavian low spread south-east, giving a cold northerly current over north-west Europe. Fair weather was general, but some snow storms occurred and thunder was reported from Banff on the 3rd and Yarmouth on the 4th. A backing wind and falling barometer in Iceland and the western districts of the British Isles on the evening of the 5th indicated the approach of further disturbances from the west, and during the 6th, 7th and 8th the westerly type was re-established with a rise of temperature spreading in from the west.

Rain was particularly heavy in Switzerland on Jan. 8th, 35 mm. falling at Zurich and 33 mm. at Geneva.

From the 8th to the 11th a sequence of changes in the pressure distribution, closely resembling that from the 1st to the 5th, occurred. On the 9th a broad, warm, westerly current spread from France to Iceland. Heavy rain occurred in many places, 24 mm. being reported from Eskdalemuir. On the 10th the wind veered behind a depression crossing Norway, with a consequent fall of temperature over the British Isles. A thunderstorm occurred at Wick, and heavy rain fell in northern Germany. The 11th was a colder, brighter day, with snow and hail showers and lightning at Cranwell.

On the morning of the 12th a tongue of high pressure extended from the Azores over Ireland. This " high " moved eastwards over the British Isles, giving a fine, cold day with keen frosts at night and local fogs. During the 13th a V-shaped depression cut into the belt of high pressure, so that pressure was high over Scandinavia and the Azores and comparatively low over the British Isles. This Scandinavian " high " persisted for the rest of the month and was the chief feature of the weather map. On the 14th the V had developed into a typical cyclone over southern England, but rapidly diminished in intensity, having no supply of warm air. The temperature in all districts was low, and snow fell in Scandinavia, Denmark, and north Germany from a cold north-east wind.

On the morning of the 15th a warm southerly current was touching the western districts of the British Isles and the barometer falling very quickly. During the day a depression moved quickly across England, causing heavy rain or snow in all districts. By the morning of the 16th the centre of this depression was over the North Sea, and the cold north-west current behind it had joined up with the cold air over France, completely shutting off the supply of warm air. The depression, which had been moving very quickly, became almost stationary and proceeded to fill up, so that by the evening of the 18th it was almost unrecognisable on the map.

From the 18th the " high " over the Baltic gradually increased in intensity and extended its influence eastwards, while pressure remained low over the Atlantic, west of Ireland, giving low temperatures and easterly winds in southern Scandinavia and the Netherlands, but fairly warm weather in the western half of the British Isles and Iceland, where the air supply was drawn from the southern Atlantic. Temperatures on the morning of the 23rd may be quoted as typical of the conditions before the cold easterly drift along the southern side of the Baltic " high " had affected the west of the British Isles. On the Baltic coast of Germany temperatures ranged about 0° F., Hamburg 16° F., The Helder 30° F., Yarmouth 38° F., Pembroke 48° F., Valencia 53° F., Reykjavik (Iceland) 49° F., and the coast of Norway 36° F. These can be compared with the same places two days later on the morning of the 25th: Baltic coast of Germany 0° F., Hamburg 12° F., The Helder 21° F., Yarmouth 36° F., Pembroke 32° F., Valencia 37° F., Reykjavik 34° F. On the Norwegian coasts temperatures were irregular from 41° F. to 30° F., the higher temperatures probably being due to a Föhn effect over the Scandinavian hills.

The very thick fog which occurred in London and elsewhere in England on the 22nd was occasioned by the conjunction of the very cold easterly air with the much warmer air from the south.

On the 25th a depression appearing off the south-west coast of the British Isles moved north slowly, bringing a warmer air supply which gradually spread from the west across the British Isles. The meeting place of the two currents—the warm from the depression to the west and the cold from the Scandinavian "high"—was clearly marked, particularly on the weather map of the 26th, as a narrow ribbon, extending from Brussels to Aberdeen along the east coast of Britain, over which rain was falling and mists or fogs occurred.

By Saturday, 28th, the whole of the British Isles and northern France were definitely in this warmer current, and the anticyclone over the Baltic had diminished in intensity.

The last two or three days of the month were mild and unsettled in the British Isles and France owing to the warm air coming round the large Atlantic depression. The weather in Scandinavia, North Germany and the Netherlands remained cold but, with the anticyclone diminishing in intensity and thus permitting the slow drifting in of warmer air, the temperature was slowly rising.

R. A. W.

There was a general snowfall over France on the 15th; around Amiens the snow was accompanied by a violent gale. The lowest temperature recorded seems to have been 3° F. at Pontarlier (Doubs). A hurricane swept the coast of Portugal on the night of the 17th, causing much loss of life and general damage. Northern Germany experienced a spell of severe cold near the end of the month; Kiel Harbour was completely frozen over for the first time in many years. In Switzerland the depth of snow has increased, and the facilities for winter sports are more nearly normal.

At the beginning of the month the seven months' drought in Northern Italy was still continuing. Heavy rain and snow fell in the Calabrian provinces on the 10th and subsequent days, and on the night of the 17th the drought in the north was broken by a considerable fall of snow over the whole of the country between Venice and Milan. In the Arlberg district of the Rhætian Alps snow-avalanches interrupted the Paris–Vienna railway services for several days.

On the 4th a violent gale and hailstorm caused the destruction of several sailing vessels at Salonika. Later in the month twenty persons were killed by lightning during a severe thunderstorm in the Lebanon.

A message from *The Times* of the 17th states that Indian crop prospects continue to be good, though more rain is needed in the Punjab and parts of Madras.

A Sydney cable, dated on the 27th, reports rainfall varying from 6 mm. to 25 mm. over New South Wales.

(*Continued on* p. 32.)

Rainfall Table for January 1922.

STATION.	COUNTY.	Aver. 1881—1915.	1922.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	1·86	2·81	71	151	·70	18	20
Tenterden (View Tower)	*Kent*	2·15	4·02	102	187	·78	19	19
Arundel (Patching Farm)	*Sussex*	2·60	4·31	109	166	·69	19	20
Fordingbridge (Oaklands)	*Hampshire*	2·76	4·77	121	173	·91	18	25
Oxford (Magdalen College)	*Oxfordshire*	1·72	2·29	58	133	·34	13	22
Wellingborough (Swanspool)	*Northampton*	1·85	3·42	87	185	·97	15	22
Hawkedon Rectory	*Suffolk*	1·74	3·39	86	195	·45	15	22
Norwich (Eaton)	*Norfolk*	1·96	5·20	132	265	·63	4	25
Launceston (Polapit Tamar)	*Devon*	3·72	5·20	132	140	·65	15	27
Sidmouth (Sidmount)	"	2·86	4·39	112	154	·74	30	23
Ross (County Observatory)	*Herefordshire*	2·42	3·50	89	145	·42	15	23
Church Stretton (Wolstaston)	*Shropshire*	2·53	4·75	121	188	·53	3, 28	25
Boston (Black Sluice)	*Lincoln*	1·62	2·21	56	136	·30	19	22
Worksop (Hodsock Priory)	*Nottingham*	1·77	2·98	75	168	·48	26	20
Mickleover (Clyd House)	*Derbyshire*	2·02	3·62	92	179	·86	26	20
Southport (Hesketh Park)	*Lancashire*	2·55	3·83	97	150	·80	15	22
Harrogate (Harlow Moor Ob.)	*York, W. R.*	2·44	3·98	101	163	·68	27	24
Hull (Pearson Park)	" *E. R.*	1·80	2·82	72	157	·63	15	23
Newcastle (Town Moor)	*North'land*	2·04	2·94	75	144	·52	25	20
Borrowdale (Seathwaite)	*Cumberland*	13·28	9·80	249	74	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	3·78	4·55	116	120	·85	15	27
Haverfordwest (Gram. Sch.)	*Pembroke*	4·61	6·25	159	136	·81	20	24
Aberystwyth (Gogerddan)	*Cardigan*	4·09	5·83	148	143	1·04	15	20
Llandudno	*Carnarvon*	2·58	3·39	86	131	·53	16	23
Dumfries (Cargen)	*Kirkcudbrt.*	3·99	5·67	144	142	·87	15	20
Marchmont House	*Berwick*	2·25	2·93	74	130	·37	13	21
Girvan (Pinmore)	*Ayr*	4·72	7·11	181	151	·97	18	24
Glasgow (Queen's Park)	*Renfrew*	3·34	3·40	86	102	·40	8, 9	23
Islay (Eallabus)	*Argyll*	4·68	7·24	184	155	1·17	15	28
Mull (Quinish)	"	5·60	6·43	163	115	1·20	17	24
Loch Dhu	*Perth*	9·10	12·05	306	132	1·95	1	24
Dundee (Eastern Necropolis)	*Forfar*	1·95	3·35	85	172	·46	18	21
Braemar (Bank)	*Aberdeen*	3·08	6·59	167	214	·87	28	29
Aberdeen (Cranford)	"	2·38	4·80	122	202	·83	15	24
Gordon Castle	*Moray*	2·02	2·78	71	138	·40	1	28
Fort William (Atholl Bank)	*Inverness*	9·58	5·46	139	57	·68	31	25
Alness (Ardross Castle)	*Ross*	3·80	4·16	106	109	·67	15	20
Loch Torridon (Bendamph)	"	9·40	7·49	190	80	1·02	15	20
Stornoway	"	5·17	5·82	148	113	·93	15	26
Loch More (Achfary)	*Sutherland*	7·28	6·12	155	84	1·25	1	23
Wick	*Caithness*	2·46	3·26	83	133	·70	1	22
Glanmire (Lota Lodge)	*Cork*	4·30	5·75	146	134	·75	20	23
Killarney (District Asylum)	*Kerry*	5·92	7·35	187	124	1·14	17	29
Waterford (Brook Lodge)	*Waterford*	3·69	4·49	114	122	·60	20,27	22
Nenagh (Castle Lough)	*Tipperary*	3·96	4·79	122	121	·80	17	26
Ennistymon House	*Clare*	4·20	7·07	180	168	·81	28	27
Gorey (Courtown House)	*Wexford*	3·12	3·66	93	117	·69	20	23
Abbey Leix (Blandsfort)	*Queen's Co.*	3·28	3·67	93	112	·48	15	23
Dublin (FitzWilliam Square)	*Dublin*	2·29	2·28	58	100	·40	25	21
Mullingar (Belvedere)	*Westmeath*	3·21	3·31	84	103	·50	14	24
Woodlawn	*Galway*	3·82	..	..	..	..	..	..
Crossmolina (Enniscoe)	*Mayo*	5·24	6·06	154	116	·66	14	30
Collooney (Markree Obsy.)	*Sligo*	3·90	5·25	133	135	·68	14	27
Seaforde	*Down*	3·15	3·80	97	121	·61	18	24
Ballymena (Harryville)	*Antrim*	3·71	5·24	133	141	·95	14	29
Omagh (Edenfel)	*Tyrone*	3·54	5·16	131	146	·61	8	24

Supplementary Rainfall, January 1922.

Div.	STATION.	RAIN.		Div.	STATION.	RAIN.	
		in.	mm.			in.	mm.
II.	Ramsgate	2·40	61	XII.	Langholm, Drove Rd.	5·38	137
,,	Sevenoaks, Speldhurst	3·99	101	XIII.	Ettrick Manse	4·79	122
,,	Hailsham Vicarage...	4·26	108	,,	North Berwick Res....	1·83	47
,,	Totland Bay, Aston ..	5·06	129	,,	Edinburgh, Royal Ob.	1·41	36
,,	Ashley, Old Manor Ho.	5·05	128	XIV.	Biggar...............	3·34	85
,,	Grayshott...........	5·44	138	,,	Leadhills	13·92	354
,,	Ufton Nervet........	2·90	74	,,	Kilmarnock, Agric.Coll.	3·15	80
III.	Harrow Weald, Hill Ho.	3·17	81	XV.	Dougarie Lodge.......	5·72	145
,,	Pitsford, Sedgebrook..	3·56	90	,,	Oban................	4·77	121
,,	Chatteris, The Priory.	2·15	55	,,	Inveraray Castle......	9·24	235
IV.	Elsenham, Gaunts End	3·45	88	,,	Holy Loch, Ardnadam	8·10	206
,,	Lexden, Hill House ..	4·03	102	XVI.	Loch Venachar	7·40	188
,,	Aylsham, Rippon Hall	5·17	131	,,	Blaircreach	11·46	291
,,	Swaffham...........	3·42	87	,,	Loch Rannoch, Dall...	6·84	174
V.	Devizes, Highclere ...	3·27	83	,,	Blair Atholl	5·26	134
,,	Weymouth..........	4·12	105	,,	Coupar Angus........	4·39	111
,,	Ashburton, Druid Ho.	6·97	177	,,	Montrose Asylum	3·94	100
,,	Cullompton	4·60	117	XVII.	Logie Coldstone, School	5·16	131
,,	Hartland Abbey	3·96	101	,,	Fyvie Castle..........	5·22	133
,,	Penzance, Trengwainton	6·12	155	,,	Grantown-on-Spey ...	2·72	69
,,	St. Austell, Trevarna.	6·83	173	XVIII.	Kingussie, Fasnakyle..	4·28	109
,,	Crewkerne Merefield Ho	5·88	149	,,	Fort Augustus........	3·06	78
VI.	Clifton, Stoke Bishop.	..	..	,,	Loch Quoich, Loan ...	14·90	379
,,	Ledbury, Underdown.	3·96	101	,,	Fortrose	2·70	69
,,	Shifnal, Hatton Grange	3·87	98	,,	Faire-na-Squir........	4·68	119
,,	Ashbourne, Mayfield.	4·89	124	,,	Skye, Dunvegan	6·33	161
,,	Barnt Green, Upwood	3·18	81	XIX.	Loch Carron, Plockton	4·87	124
,,	Blockley, Upton Wold	3·67	93	,,	Dornoch, St. Gilberts .	2·70	69
VII.	Leicester, Town Hall Sq.	3·11	79	,,	Tongue Manse	3·78	96
,,	Grantham, Saltersford	2·13	54	XX.	Melvich Schoolhouse ..	4·06	103
,,	Louth, Westgate	3·50	89	,,	Dunmanway Rectory..	9·81	249
,,	Mansfield, West Bank	4·18	106	,,	Mitchelstown Castle...	3·79	96
VIII.	Nantwich, Dorfold Hall	3·83	97	,,	Gearahameen	1·50	38
,,	Bolton, Queen's Park.	4·79	122	,,	Darrynane Abbey	7·94	202
,,	Lancaster, Strathspey.	3·78	96	,,	Cashel, Ballinamona...	3·68	93
IX.	Wath-upon-Dearne...	3·25	83	,,	Roscrea, Timoney Pk..	3·09	79
,,	Bradford, Lister Park.	4·54	115	,,	Foynes	4·52	115
,,	West Witton.........	..	..	,,	Broadford. Hurdlesto'n	4·58	116
,,	Scarborough, Scalby..	4·15	105	XXI.	Kilkenny Castle.......	3·25	83
,,	Middlesbro', Albert Pk.	1·77	45	,,	Rathnew, Clonmannon	3·89	99
,,	Mickleton...........	3·50	89	,,	Hacketstown Rectory .	4·51	115
X.	Bellingham	6·84	174	,,	Balbriggan, Ardgillan .	2·70	69
,,	Ilderton, Lilburn	4·04	103	,,	Drogheda	2·35	60
,,	Orton...............	5·08	129	,,	Athlone, Twyford	2·86	73
XI.	Llanfrechfa Grange ..	4·16	106	XXII.	Castle Forbes Gdns....	4·07	103
,,	Treherbert, Tyn-y-waun	9·12	232	,,	Ballynahinch Castle...	8·11	206
,,	Carmarthen Friary ..	5·99	152	,,	Galway Grammar Sch.	3·53	90
,,	Lampeter, Falcondale	6·35	161	XXIII.	Westport House	5·35	136
,,	Cray Station	8·00	203	,,	Enniskillen, Portora...	4·08	104
,,	B'ham W.W., Tyrmyndd	9·07	230	,,	Armagh Observatory ..	3·31	84
,,	Lake Vyrnwy.......	7·83	199	,,	Warrenpoint	3·93	100
,,	Llangynhafal, P. Drâw	4·10	104	,,	Belfast, Cave Hill Rd..	3·88	99
,,	Oakley Quarries	8·53	217	,,	Glenarm Castle	5·25	133
,,	Dolgelly, Bryntirion..	6·63	168	,,	Londonderry, Creggan.	4·16	106
,,	Snowdon, L. Llydaw.	17·14	435	,,	Sion Mills............	4·40	112
,,	Lligwy	3·04	77	,,	Milford, The Manse ...	4·85	123
XII.	Stoneykirk, Ardwell Ho.	6·11	155	,,	Narin, Kiltoorish	4·83	123
,,	Carsphairn, Shiel.....	10·42	265	,,	Killybegs, Rockmount .	6·41	163

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L. mb.	Diff. from Normal mb.	Max. ° F.	Date	Min. ° F.	Date	Max. ° F.	Min. ° F.	½ max. and min. ° F.	Diff. from Normal ° F.
London, Kew Observatory	1013·6	−1·4	81	19	41	31	71·1	54·5	62·8	+1·2
Gibraltar	1015·4	+0·2	91	3	61	11, 13	81·3	67·6	74·5	−1·4
Malta	1013·6	−0·8	93	1	62	26	84·2	73·3	78·7	+0·5
Sierra Leone	1013·0	−0·3	86	1, 5	69	25	82·4	72·5	77·5	−0·6
Lagos, Nigeria	1014·1	+0·5	85	31	71	21	83·0	73·7	78·3	+1·2
Kaduna, Nigeria	1014·2	+0·4	90	26	64	31	81·5	66·9	74·2	+0·4
Zomba, Nyasaland	1017·2	+1·0	81	9, 18, 28	45	5	75·9	54·3	65·1	+0·4
Salisbury, Rhodesia	1018·7	−0·4	83	11	35	1	75·2	42·8	59·0	−0·9
Cape Town	1020·9	+0·7	72	24	39	10	59·9	46·0	52·9	−2·3
Johannesburg	1022·1	−0·1	73	18	26	10	64·8	42·1	53·5	−0·4
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	..	..	77	17	22	3	66·2	33·5	49·9	−2·3
Calcutta, Alipore Obsy.	999·3	−1·7	91	10	76	26	87·5	78·7	83·1	+0·1
Bombay	1004·9	−0·8	86	4	76	10	83·8	77·2	80·5	−0·2
Madras	1005·5	0·0	98	23	73	25	93·6	77·6	85·6	−0·1
Colombo, Ceylon	1009·4	+0·5	87	17	72	10	85·3	77·1	81·2	−0·3
Hong Kong	1003·6	−1·6	92	22	74	8	87·4	78·6	83·0	+0·9
Sandakan	..	..	92	16, 18	72	3, 29, 30	88·1	75·1	81·6	−0·3
Sydney	1021·4	+3·2	74	10	40	6	64·8	45·2	55·0	+0·1
Melbourne	1021·2	+3·2	67	21	36	3	57·5	43·5	50·5	−0·6
Adelaide	1023·2	+4·0	75	21	37	6	62·0	44·3	53·1	−0·8
Perth, Western Australia	1021·2	+2·4	79	29	41	26	65·7	48·5	57·1	+1·1
Coolgardie	1022·1	+2·8	80	31	35	10	66·4	43·2	54·8	+1·2
Brisbane	1022·3	+3·3	75	27	42	6	67·9	49·2	58·5	−2·0
Hobart, Tasmania	1014·2	+0·6	65	21	32	1, 19	54·5	41·1	47·8	−0·1
Wellington, N.Z.	1015·7	+1·0	60	23	31	7	55·7	42·3	49·0	+0·5
Suva, Fiji	1014·6	+0·3	85	5	59	10	83·9	62·0	72·9	−0·8
Kingston, Jamaica	1014·3	+0·6	93	22	71	25	90·2	73·0	81·6	+0·1
Grenada, W.I.	1010·5	−2·1	90	9	70	10	85·1	74·7	79·9	+0·4
Toronto	1017·3	+1·9	91	30	47	22	78·4	57·6	68·0	+1·4
Winnipeg	1014·1	+0·2	94	31	41	20	76·3	51·8	64·1	+1·1
St. John, N.B.	1016·3	+0·9	77	3	46	26	68	52	60	−0·5
Victoria, B.C.	1017·6	+0·4	76	7	48	11	65·8	50·9	58·3	−1·8

London, Kew Observatory.—Mean speed of wind 7·4 mi/hr; 3 days with thunder heard.

Gibraltar.—1 day with thunder heard.

Malta.—Prevailing wind direction NWly; 1 day with thunder heard.

Sierra Leone.—Prevailing wind direction SW; 3 days with thunder heard.

Madras.—15 days with thunder heard.

Colombo, Ceylon.—Prevailing wind direction WSW, mean speed 5·6 mi/hr; 2 days with thunder heard. Vigorous thunderstorms inland but not at Colombo.

Melbourne :—										
November 1920	1015·4	+1·3	88	8	41	3	70·7	52·6	61·7	+0·4

Abs. max. in sun 148° F.

Kaduna, Nigeria.—Pressure diffs. from normal for Jan. to July 1921 should read :-

British Empire, August 1921.

TEMPERATURE		Relative Humidity	Mean Cloud Am'nt	PRECIPITATION				BRIGHT SUNSHINE		STATIONS
Mean Wet Bulb.	Absolute Min. on Grass			Amount		Diff. from Normal	Days	Hours per day	Percentage of possible	
°F.	°F.	%	0–10	in.	mm.	mm.				
57·8	33	66	6·5	0·99	25	− 32	6	5·4	37	London, Kew Observatory.
68·1	57	74	2·5	0·28	7	+ 3	1	..	..	Gibraltar.
72·7	62	68	2·1	0·23	6	+ 3	4	10·2	76	Malta.
73·7	..	84	8·7	48·56	1233	+319	29	..	..	Sierra Leone.
74·1	69	78	9·4	3·53	90	+ 22	16	..	..	Lagos, Nigeria.
69·5	..	89	..	11·73	298	+ 2	18	..	..	Kaduna, Nigeria.
..	..	77	3·5	0·70	18	+ 10	3	..	..	Zomba, Nyasaland.
49·9	28	49	1·2	0·00	0	− 2	0	..	..	Salisbury, Rhodesia.
50·7	..	78	5·8	4·04	103	+ 16	15	..	..	Cape Town.
39·3	25	47	0·6	trace	trace	− 9	0	10·1	91	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
37·3	..	56	1·5	0·00	0	− 12	0	..	..	Bloemfontein.
80·3	74	81	9·2	16·82	427	+118	19*	..	..	Calcutta, Alipore Obsy.
76·7	71	83	8·3	10·37	263	− 97	28*	..	..	Bombay.
76·6	..	77	6·3	7·28	185	+ 60	9*	..	..	Madras.
77·4	71	76	8·8	3·44	87	+ 2	23	..	..	Colombo, Ceylon.
77·9	..	82	6·2	15·45	392	+ 27	10	8·0	62	Hong Kong.
76·1	..	82	..	9·88	251	+ 46	12	..	..	Sandakan.
49·7	30	62	2·1	0·95	24	− 55	5	8·6	79	Sydney.
47·6	34	74	6·4	3·06	78	+ 32	17	..	..	Melbourne.
48·5	27	67	5·1	2·20	56	− 8	14	5·8	54	Adelaide.
53·4	32	68	4·6	3·68	93	− 50	16	..	..	Perth, Western Australia.
49·5	31	50	4·3	1·57	40	+ 14	7	..	..	Coolgardie.
54·2	31	63	4·1	0·41	10	− 47	7	..	..	Brisbane.
43·7	23	69	6·5	2·52	64	+ 18	17	..	..	Hobart, Tasmania.
..	21	78	5·3	3·25	83	− 33	14	5·7	55	Wellington, N.Z.
73·1	..	94	..	11·30	287	+ 78	17	..	..	Suva, Fiji.
..	..	75	6·7	1·22	31	− 62	9	..	..	Kingston, Jamaica.
75·7	..	75	4·7	10·60	269	+ 30	23	..	..	Grenada, W.I.
61·0	43	75	4·0	2·07	53	− 17	9	..	..	Toronto.
59·2	..	81	3·7	2·46	62	+ 2	10	..	..	Winnipeg.
55·4	42	78	4·5	2·42	61	− 37	6	..	..	St. John, N.B.
53·7	41	80	4·0	0·85	22	+ 5	8	..	..	Victoria, B.C.

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

Hong Kong.—Prevailing wind direction S, mean speed 8·5 mi/hr; 10 days with thunder heard.

Melbourne.—All northern rivers in flood.

Brisbane.—Mean temp. and mean max. lowest on record for August.

Wellington, N.Z.—3 days with hail, 1 day with thunder heard, 1 day with fog.

Grenada.—Prevailing wind direction E; 3 days with thunder heard.

56·7	34	61	6·5	3·21	82	+ 24	8	..	..	Melbourne :— November 1920

nb. Jan. + 2·8, Feb. + 1·2, Mar. + 1·9, Apl. + 2·1, May + 0·1, June 0·0, July + 0·5.

A very severe hurricane, following a heavy fall of hail and snow, raged in New York City on the 11th. The wind is said to have attained a force of 100 m.p.h., and in many places pedestrians could only progress in groups or by holding on to improvised life lines. Three persons were killed and fifty injured. Eight days later one of the thickest fogs ever observed by the Weather Bureau occurred, shipping being unable to enter the harbour.

The special message from Brazil states that rain has been generally deficient except in the coffee and wheat regions of San Paulo and Rio Grande. Temperatures were above normal over the whole country, and the anticyclonic conditions which bring the cool, north-east trade wind to the coasts at this season of the year were absent.

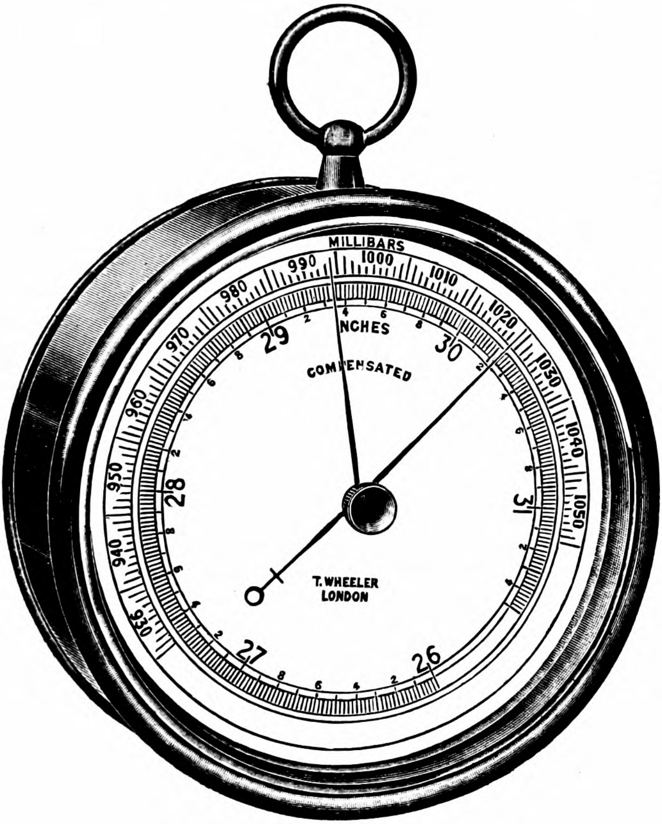
The rainfall was above the average generally over the British Isles, failing to reach this amount only in the English Lake District and the north-west of Scotland. The greater portion of the centre and south-east of England, and parts of the east of Scotland and west of Clare received more than 150 per cent. of the average. In Norfolk and Aberdeenshire more than twice the average occurred, reaching as much as 265 per cent. of the average at Norwich, where the rainfall was the heaviest recorded since records began in 1865. The distribution of rainfall was thus such as to bring the dry period which was so prominent a feature of 1921, to an end, the fall being greatest in the districts where the drought had been most acute. It was also notable that heavy daily falls were remarkably few, only a small number of stations recording more than 25 mm. in one day. Falls of less than 50 mm. (2 inches) during the month were confined to the neighbourhood of the Wash, the Valley of the Tweed, and along the Firth of Forth. More than 250 mm. (10 inches) was recorded locally among the mountains of Central Wales, near Loch Lomond, in Western Inverness-shire, Kerry, Connemara, and Down.

The general rainfall for the counties expressed as a percentage of the averages, were England and Wales, 148; Scotland, 131; Ireland, 126; British Isles, 141.

In London (Camden Square), the mean temperature was 40·1° F. or 1·4° F. above the average. Duration of rainfall, 70·7 hours. Evaporation, 0·16 inch.

The staff of the Meteorological Office held their Third Annual Soirée on February 11th at the Merrick Rooms, Kensington, W. The soirée took the form of a concert and dance; nearly 200 members of the staff and friends were present, Dr. G. C. Simpson, Mrs. Simpson and Sir Napier Shaw being among the number.

ANEROID BAROMETERS
GRADUATED IN MILLIBARS.
As supplied to
THE METEOROLOGICAL OFFICE.


MILLIBARS
930
940
950
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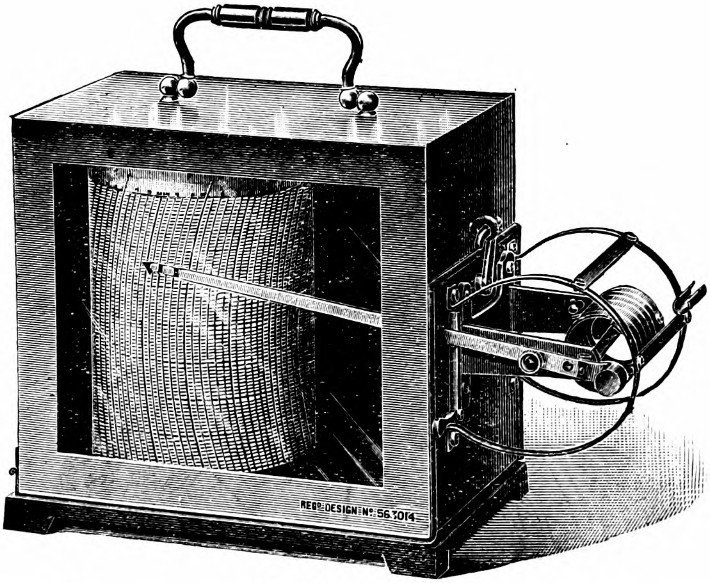
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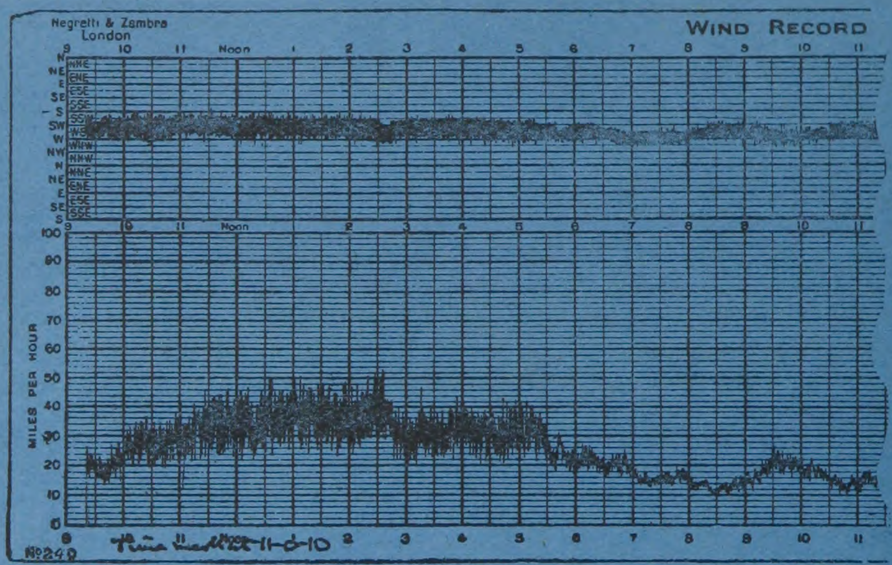

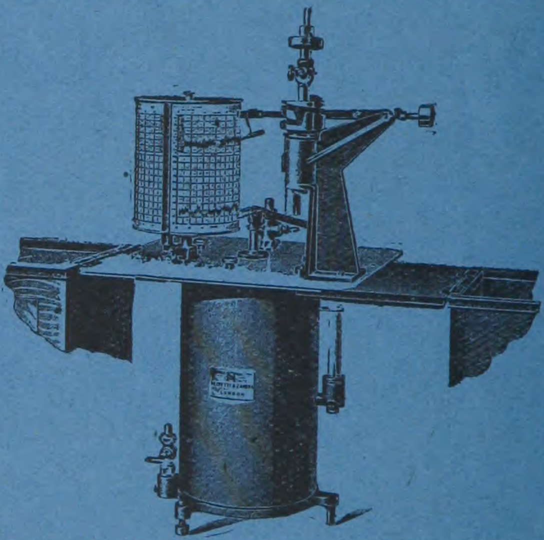

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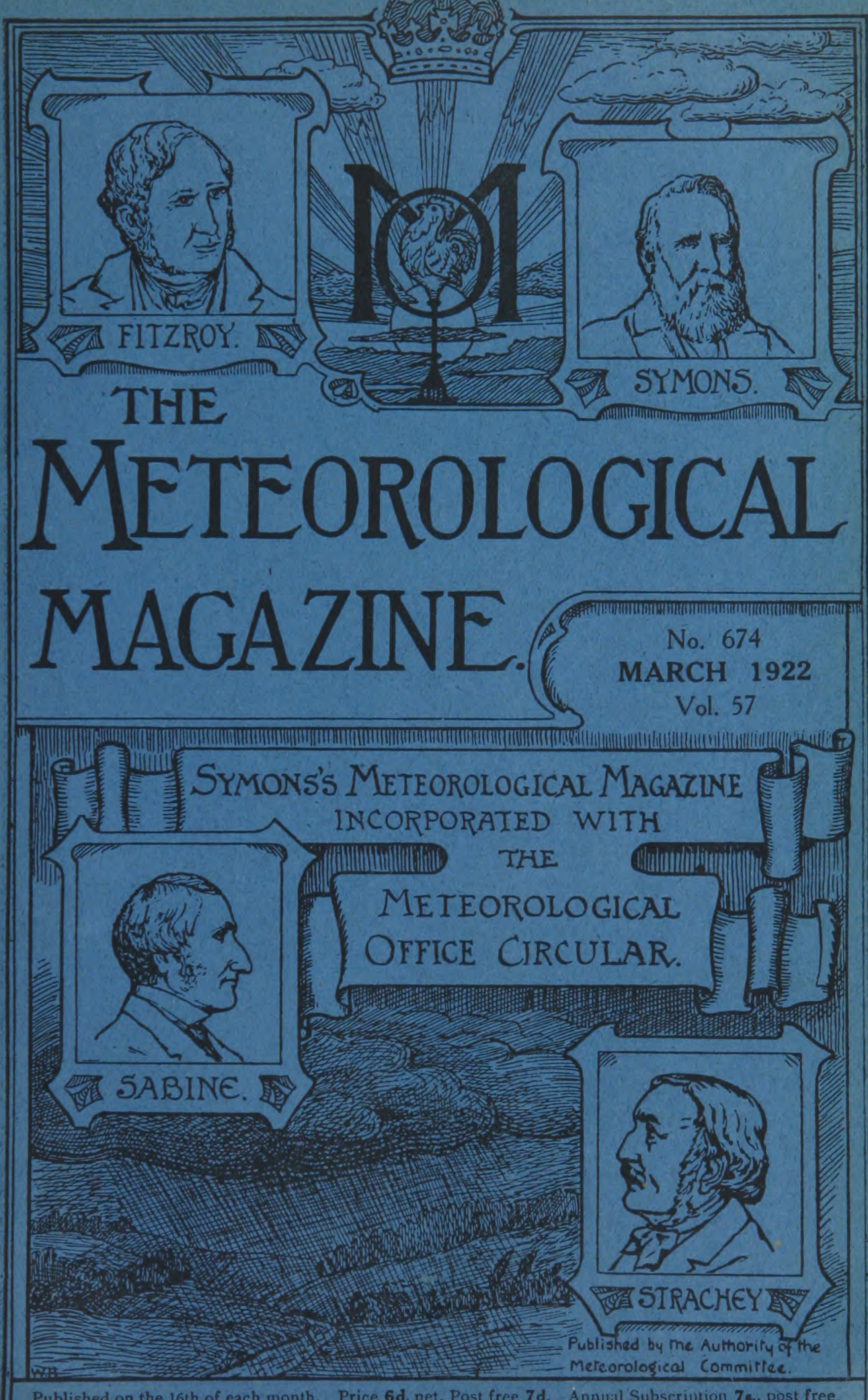

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No. 674
MARCH 1922
Vol. 57

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The responsibility for all facts and opinions expressed in the signed articles and letters published in this Magazine rests with their respective authors.

MARCH 1922.
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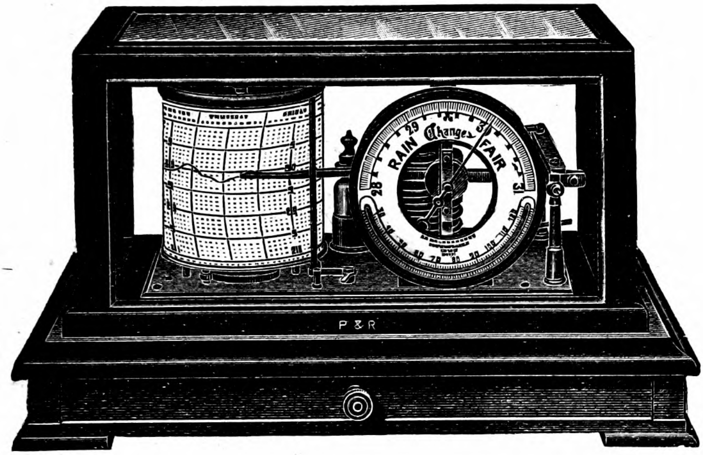

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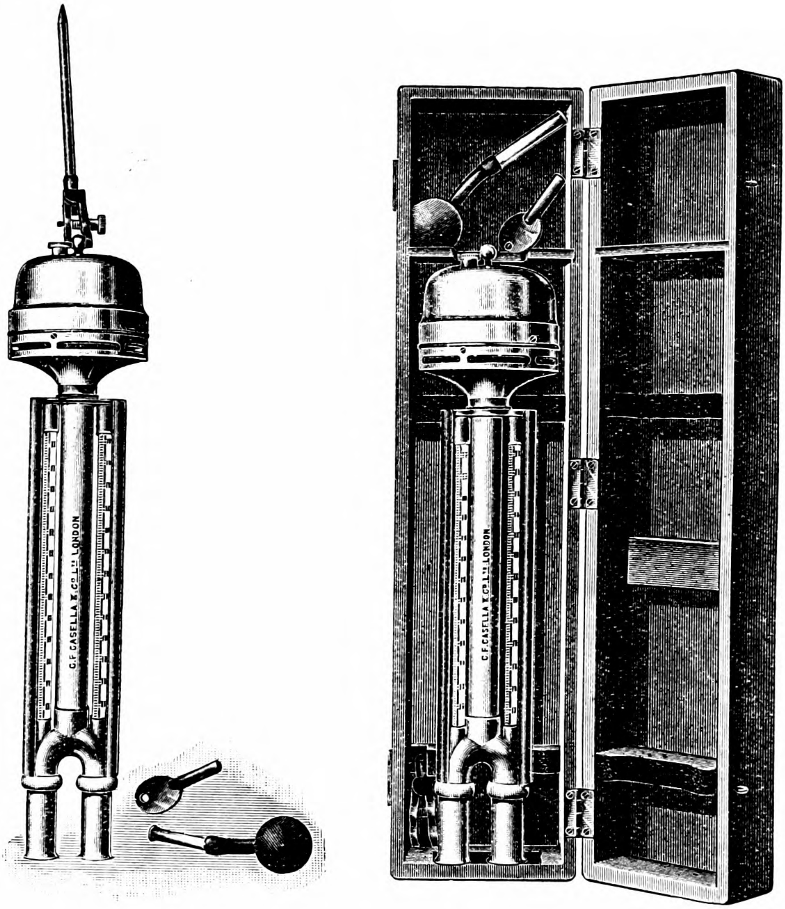
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Land- and Sea-Breezes in the Gulf of Lions.

By Professor M. MOYE.

LAND-BREEZES and sea-breezes are a distinctive feature of the summer climate of the French and Catalonian coasts of the Mediterranean Sea. They are much more marked here than on the Channel or Atlantic shores where they are often masked by the general circulation of the atmosphere. In the Mediterranean Sea, surface winds are normally light and variable in summer, and local convection currents are readily set up.

Land- and sea-breezes are well known in general terms, but much scope remains for detailed studies. It appears, therefore, to be of some interest to give a short *résumé* of our own observations at Montpellier (France) and especially of a complete investigation* planned and carried out by Prof. E. Fontséré of the Faculty of Sciences of Barcelona, Director of the Aeronautical Station.

Sea-breezes begin at Barcelona in March, blowing on about four days out of ten. In April and May, they blow on more than six days out of ten. From July 15th to August 15th sea-breezes are recorded on nine days out of ten. They slowly decrease in frequency in September and practically disappear by the end of October. At Montpellier, local shore-winds are much less frequent. They are rare before mid-May and after

---

* *Sobre els vents estivals de Conveccio a la Costa Catalana.*—Barcelona, 1918. (*See* Reviews in *Meteorological Magazine*, September, 1919, p. 92, and in *Meteorological Office Circular*, No. 34, p. 4.)

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September. But in both stations their frequency varies with the summer temperature. At Barcelona as at Montpellier, the direction of sea-breezes is almost always from south or south-south-west. It should be noted that the direction is rather tangential to the Catalonian coast, but perpendicular to that of France. The winds are probably caused by convection currents, not only in a restricted area close to the sea, but also over a large area inland.

Sea-breezes begin, as a rule, after a short period of calm and are followed by another calm of longer duration. In the night and early morning, land-breezes blow gently, but not from an opposite direction. In fact, both land- and sea-breezes are slowly rotating with the apparent motion of the sun, or, to use the usual term, veering. Backing, or rotation from south to north by east is not unknown, but is much less frequent than veering, giving only 20 per cent. of the possible cases at Barcelona.

Sea-breeze, beginning from a south or south-west direction, comes from south-west or west-south-west in the afternoon. Evening or night land-breezes blow from north-west or north, but this direction is not quite stable and, often, it varies at random until the morning. Our observations at Montpellier are in perfect agreement with those of Professor Fontséré.

The hours of beginning and ending are of special interest. Professor Fontséré has collected and put in order many observations from 31 stations, both on the coast and inland. In mid-summer, the sea-breeze rises about 8 a.m. almost simultaneously all along the coast. Then it spreads in opposite directions, seawards and landwards, always blowing from the same quarter, the affected area increasing in width at a rate of about 8 miles per hour. At mid-day the sea-breeze, travelling inland, has reached its furthest extension, about 25 to 30 miles from the shore. In the meantime, its velocity keeps steadily increasing, the maximum coming at 2 p.m. on the coast and 5 p.m. inland. The end is quite abrupt, taking place sharply at 6 p.m. over the whole area, marine and continental.

Sea-breezes blow, as a rule, more strongly than land-breezes, with occasional exceptions and subject to the influence of the general distribution of pressure. When the barometric gradient is favourable to wind from the north-western quadrant, a common phenomenon on the Mediterranean coasts, it is clear that sea-breeze is in opposition and remains quite light. In fact, at Montpellier, with a light wind from north-west in the morning, the only effect analogous to the sea-breeze is a dead calm in the afternoon, with a sultry and close atmosphere.

The force of a normal sea-breeze as registered by the anemograph at the Barcelona station corresponds with 4 or 5 on the Beaufort scale. At Montpellier, the breeze is rather lighter, not exceeding force 3 or 4, the maximum velocity being reached, as indicated above, between 3 and 5 p.m. Land-breezes are always very light, often falling almost to a calm. They are also irregular in the small hours of the night, blowing by little puffs from any part of the horizon. At sunrise, the land-breeze increases somewhat, before the calm, just before the coming of the sea-breeze.

Land- and sea-breezes are essentially surface currents. It follows they must be supplemented by a return circulation in high atmosphere.

Professor Fontséré tested these points by ascents of pilot balloons. His results are that sea-breezes begin at a very moderate height, 300 or 400 feet only, the superior limit rises steadily and reaches 3,000 to 4,000 feet in early afternoon. On the French coast this height is rather less, about 2,000 feet at Toulon.

Above the sea-breeze there is a layer of calm which has a depth of 700 to 800 feet. Above this layer flows the return circulation, which may reach up to 10,000 feet, when it is lost in the general circulation of the upper atmosphere. The direction of the return circulation is not diametrically opposed to the surface current. It blows from points between south-west and north, varying day by day, with a notable predominance of the north-west quadrant. In the afternoon, the return circulation may slowly veer northwards, but there is always a component towards the sea. Indeed, this fact is a serious drawback to aerological soundings by ballons-sondes, the registering apparatus of which is very often lost at sea.

Sea-breezes do not cause, on the French or Catalonian coasts, the great changes of temperature which are so noticeable in tropical regions. The thermometer rises sharply in summer from 7 to 11 a.m. and then quite slowly until 2 or 3 p.m. The change in relative humidity is also moderate, as might be anticipated from the narrow band of sea swept by the coming breeze. In Catalonia, however, sea-breezes bring in shore clouds of the cumulus type which dissolve away in the late afternoon. At Montpellier it is only occasionally that the sea-breeze disturbs the clearness of the sky.

From a biological point of view, sea-breezes are very welcome, helping us to support a summer heat and making the afternoon often pleasanter than the morning or evening.

The British Rainfall Organization.

Removal of Headquarters to South Kensington.

READERS of the *Meteorological Magazine* are aware that on the retirement of Dr. H. R. Mill, in July 1919, the British Rainfall Organization was attached to the Meteorological Office, and has since that date been carried on as an integral part of the official meteorological service of the country. Up to the present time the work has been continued at the old headquarters at 62, Camden Square, London, N.W.1, the house around which so much of the history of the Organization has centred, but it is felt that the time has now come when co-operation with the other departments of the Office will be greatly facilitated by having the British Rainfall Organization in the building occupied by the Meteorological Office in Exhibition Road, South Kensington, and it is proposed to transfer the Offices of the Organization to that address on March 20th. The building in Exhibition Road, which was largely designed in 1910 by Sir Napier Shaw, was originally intended to house the whole of the Meteorological Office, but the absorption of the Office in the Air Ministry made it necessary recently to place some of the departments at the Air Ministry in Kingsway. The departments now occupying the Office at Exhibition Road are those dealing with Climatology and Instruments, so that the addition of the British Rainfall Organization work will be appropriate.

One of the matters which has given rise to some anxiety has been the possibility that it might be necessary to discontinue the old series of meteorological observations at Camden Square. These records were commenced by the late Mr. G. J. Symons in 1857, not as a matter of fact precisely in the same site as the station now occupies, but in the neighbouring garden of 136, Camden Road, about 250 yards to the south-west. The instruments were removed in 1869 to their present position.

The observations in 1857 were broken, but from January 5th, 1858, a complete daily series extends to the present day, comprising pressure, temperature, rainfall and other elements. From time to time other instruments have been added, the most important being a self-recording rain gauge, in 1881, and an evaporation tank in 1885. The records of rainfall duration and of evaporation are probably unique.

The house at 62, Camden Square, has remained the property of the Trustees, who remained in being for the purpose of administering the Endowment Fund, after the transfer of the responsibility for the work of the British Rainfall Organization to the Government. An arrangement has now been made by which the house and the other property of the Trust are being handed over to the Royal Meteorological Society, who have undertaken to maintain the meteorological observations and to utilize the balance of the funds for the furtherance of rainfall observing and research. It is hoped by this arrangement that the continuity of the historic record has been secured, if not in perpetuity, at least so long as the site remains suitable for the purpose.

With regard to the rainfall work, all correspondence in future should be addressed to the Superintendent, British Rainfall Organization, Meteorological Office, Air Ministry, London, W.C.2. Rainfal returns may be addressed to the Superintendent, British Rainfall Organization, Meteorological Office, South Kensington, London S.W.7. For the present any communications sent to 62, Camden Square will be forwarded. The telegraphic address is " Meteorology Southkens, London," and the telephone number Kensington 5810. The Superintendent hopes that Observers or others interested in the work will continue the pleasant custom of calling at the Office in Exhibition Road when in town.

Meteorology and Art.

AN interesting communication has been received from Mr. D. E. Row, F.R.Met.Soc., on the application of meteorology to art.

The sky plays a large part in the composition of landscape or seascape not only as a detail of the picture but also because it determines the characteristic lighting of other details. Forecasts of sky types would therefore be of great use to artists desiring to paint certain effects. Mr. Row suggests that special forecasts might be issued to meet the requirements of artists, or that artists themselves should acquire facility in forecasting local weather from the official weather map. He points out, however, that prejudice is the greatest obstacle to the success of the plan, since, to the lay mind, meteorology is too inexact to be of practical use; moreover, artists have to be persuaded that it is worth while to supplement the weather wisdom gathered in their own experience by the information which the meteorologist obtains from his charts.

Mr. Row gives instances of his own success in forecasting sky-types by using the " Further Outlook " of the *Daily Weather Report* in conjunction with local signs. He finds, for example, that complicated systems of cirrus and cirro-cumulus occur in front of a depression, while the " composite " sky in which many types of cloud at different levels may be observed is associated with a more indefinite pressure distribution, as in a secondary depression. These two sky-types, moreover, are found to be effective from the artist's point of view at sunset. But the artist's meteorology need not stop at "sky-type"; wind is of great value, for it is responsible for fine effects on trees and water as well as on the sky, while mist and haze add considerable beauty to almost any scene.

Mr. Row is to be congratulated on his success and it is to be hoped that his work will be extended. A classification of different effects of wind, cloudiness, sky coloration and so on, with the types of weather which precede them, would be very useful and the value to artists would be increased by references to examples from the Masters.

OFFICIAL NOTICES.

Meteorological Units.

As from the beginning of 1922 the partial use of the Absolute Scale of temperature in the *Weekly* and *Monthly Weather Reports* of the Meteorological Office is being given up. It will be remembered that the Absolute Scale was introduced tentatively in these Reports in 1916, the intention being to adopt it completely if the plan met with general approval.

It was anticipated that, with the development of interest in the upper air, the advantages of using an Absolute Scale of temperature for all meteorological work would become manifest; but the conservative spirit has been too strong (it is backed by some good arguments) and at present the Fahrenheit Scale is accepted even for aeronautical observations.

It has, therefore, been decided to revert to the exclusive use of the Fahrenheit Scale in the two reports of the Office intended for general use.

It is at present intended to keep to the Absolute Scale in the summaries of observations at the Observatories. There is no question of departing from it in the *Réseau Mondial.*

In the wind summaries in the *Weekly* and *Monthly Reports* it has been found possible to provide for the publication of corresponding figures in miles per hour and metres per second, so as to meet the needs of the layman as well as of the student of dynamical meteorology.

It should be added that it is considered that the millibar is now too well established for the presentation of alternative pressure units to be necessary. The practice of showing rainfall in both millimetres and inches is to continue.

Channel Forecasts.

By arrangement with Messrs. W. H. Smith and Sons, special copies of the *Daily Weather Report* have been put on sale at Victoria Station at the time of departure of the boat trains. The reports have stamped on the front page in bold, red letters "Channel Forecasts Inside," and contain a special duplicated sheet giving the probable state of the crossings from Folkestone to Boulogne and from Dover to Ostend.

Staff News.

Dr. Harold Jeffreys has given up the position of librarian at the Meteorological Office, South Kensington, to return to Cambridge as a lecturer in Applied Mathematics. Dr. Jeffreys came to the Office in 1917, when he had already made a reputation by his researches in the Physics of the Globe. Amongst the meteorological papers which he has published in the Philosophical Magazine and elsewhere, the following may be mentioned:—"On periodic convection in the atmosphere" (two papers), "Some problems in evaporation," "On travelling atmospheric disturbances," "On the relation between wind and pressure distribution," "Tidal friction in shallow seas," "On turbulence in the ocean" and "On the dynamics of wind." The importance of such papers will be more fully realised when the much-to-be-desired treatise on the mechanics of the atmosphere, designed for students with adequate mathematical equipment, comes to be written.

Mr. Arthur Hope Bell, Principal Assistant in the Climatology Division, retired at the end of February after 45 years' service in the Meteorological Office. For many years Mr. Bell had been responsible for the preparation of the *Monthly Weather Report,* work in which his knowledge of the traditions of the Office, his powers as a computer and his conscientious attention to detail were invaluable. Mr. Bell become Principal Assistant on the retirement of Mr. A. R. Simpkins a year ago.

Official Publications.

A Short Course in Elementary Meteorology. By W. H. Pick. 9½ × 6. pp. 118. 1921. 1s. 6*d*. net.

The training of cadets at the Royal Air Force College at Cranwell includes a course in meteorology. Captain W. H. Pick, who is the lecturer in this subject, qualified as a practical meteorologist in the Meteorological Section of the Royal Engineers. He saw service in France during 1918, and in January 1919 he went to Murmansk in command of the detachment attached to the North Russian Expeditionary Force. The text-book which Captain Pick has written for his classes will, it is hoped, prove useful to other students.

Discussions at the Meteorological Office.

FEB. 20th, 1922. *Agricultural Meteorology.* By J. Warren Smith. (New York: Macmillan Co. 1920.) Opener—Mr. R. H. Hooker.

THE great variety of climate within the limits of the United States and the corresponding diversity in the crops, attract numerous workers to agricultural meteorology. Professor J. Warren Smith's book is of special value as a guide to the extensive literature on his subject. Mr. Hooker's principal criticism of the work was that the mass of detail made the more important chapters rather overwhelming for such a student as might be expected to consult the "Rural Textbook Series." With regard to the correlations which have been established for so many agricultural products between the amount of the crop and the weather at critical periods of growth, it was mentioned in the discussion that information as to the mean values of the elements involved is desirable. In fact, the regression equation is required as well as the correlation co-efficient. The activity of the Weather Bureau in providing special forescast for farmers is described in the concluding chapters. Forecasts of snow or rain are distributed in the West at shearing and lambing time. Rain forecasts are issued where grapes are being dried for raisins, to enable the growers to protect the drying trays. Frost warnings are issued "for truck-growers and orchardists."

MARCH 6th, 1922. *Atlas of Tracks of 620 Typhoons, 1893–1918.* By Louis Froc, S.J. (Zi-ka-wei Observatory, 1920.) Opener—Mr. L. C. W. Bonacina.

THE collection of charts shewing the recorded paths of the typhoons of the China Seas was prepared as an Appendix to a general discussion of the subject, but it has been issued alone as experience indicated that it was desirable to place the information at the disposal of navigators without further delay. A striking feature of the charts is the way in which the few storm-centres which reach the coast of China, fail to penetrate inland. The normal distribution of pressure for the period is indicated on each chart, but it is disconcerting to find many of the isobars forked. No explanation of what such isobars are intended to indicate is to be found in the text.

Mr. Bonacina shewed slides from the office collection to illustrate the localities subject to tropical cyclones in various parts of the globe and invited discussion on the question as to why the phenomena were so much localised. He called attention to the absence of cyclones in the South Atlantic.

The Royal Meteorological Society.

THE usual monthly meeting of this Society was held on Wednesday, February 15th, at 49, Cromwell Road, South Kensington; Dr. C. Chree, F.R.S., President, in the chair. Two papers were read.

C. E. P. Brooks, M.Sc., and J. Glasspoole, B.Sc.—The Drought of 1921. The general rainfall in England and Wales in 1921 was the least, so far as can be ascertained, since 1788. Individual long records indicated that over a considerable part of the south-east of England 1921 was the driest year for at least a century and a half. The months of 1921 were not individually so remarkable, as was shown by a comparison with the driest months known to have occurred in the British Isles generally. A special comparison was also made between periods of from three to nine months' duration in 1921 with that of similar dry periods in previous years. Reference was made to a map of standard deviation of annual rainfall, 1881–1915, for the British Isles, as indicative of the areas most liable to extreme dryness. During these dry years the least fluctuations of annual rainfall occurred along the coast in the north-west of the British Isles, increasing to a maximum in the south-east and centre of the land-masses. The second half of the paper dealt with the causes of drought conditions over the British Isles. The problem was attacked by constructing charts showing the distribution of barometric pressure over the globe during and preceding each of the great droughts, beginning with 1864. It was found that the conditions which commonly prevailed during dry spells were—(1) high pressure over the British Isles, the greatest deviation from normal being usually over south-east England; (2) low pressure over the Arctic regions, especially near Spitsbergen; and (3) low pressure generally over the Tropics. The first factor was related to the eleven-year sunspot cycle, occurring most frequently two years after sunspot minimum and three or four years after sunspot maximum, so that it tended to recur every five or six years. Low pressure over the Arctic was related to ice conditions and tended to recur every four or five years. Great droughts only occurred when both these factors were favourable. With pressure low over the Arctic, two or three months' warning of a drought would be given by the development of high pressure over Northern Russia.

Professor T. Kobayasi (Imperial University of Tokio).—" On a Cyclone which crossed the Corean Peninsula, and the variations of its Polar Front." Professor Kobayasi has investigated how a cyclone passed over a mountain range in Corea on the

March 25th, 1918. The cyclone did not follow the usual process, which is for the top part to proceed across the mountain, leaving the bottom and extending itself to the surface on the other side of the mountain range; but it induced a secondary on the farther side of the range along the steering line. This secondary then extended upward until it joined with the primary at a certain height; then the secondary gradually grew stronger, when the original centre faded away and disappeared. The existence of the Polar Front was very distinctly marked, but was complicated in character. As secondaries were formed on the steering line, there were two or more squall lines for one steering line.

Correspondence.

To the Editors, Meteorological Magazine.

The Sun and the Weather.

MOST meteorologists are aware of the magnetic storm of May last year to which the Rev. A. L. Cortie refers;* but I do not think that such a storm, even though it be repeated with less intensity at each synodical rotation of the sun, can be regarded as dominating the conditions of the whole year. Although it is agreed that the year 1921 was, as compared with the average for the 35 years 1881–1915, a very dry one in the British Isles, the ratio to the average varied in the different months from 145 to 26 per cent.† and it is interesting to note that May had a rainfall only 9 per cent. less than the average. Father Cortie also says: "to judge from the horizontal component, the general magnetic field of the earth was more intense in 1921 than in 1920." Of course, the more intense the magnetic field of the earth the greater would be the proportion of electrons directed towards the poles; but this would appear to be a small factor as compared with the number of electrons shot out by the sun.

Sun-spots, when they occupy a certain position on the sun's surface as compared with the position of the earth, are potent causes of aurora and magnetic disturbances, but the chief factor seems to be the general condition of activity of the sun's equatorial belt.

R. M. DEELEY.

Tintagel, Kew Gardens Road, Kew, Surrey, January 25th, 1922.

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* *Meteorological Magazine,* Jan. 1922, Vol. 56, p. 358.
† *Ibid.,* p. 347.

The Effect of Vertical Currents on Gun-Ranging.

THE note by Mr. Britton in the last issue of the *Meteorological Magazine* (Vol. 56, p. 360) on the above subject is very interesting; but it is thought that the case as there presented is apt to give a slightly exaggerated idea of the effects produced by vertical currents.

In the first place, a shell will not be subjected to the same ascending currents as a pilot-balloon. It has been pointed out by Mr. J. S. Dines (*Advisory Committee for Aeronautics—Report No.* 47, pp. 18–19) that a pilot balloon tends to make its way into ascending rather than descending currents in the earliest stages of its ascent. If the heated air rises in the form of vortices or filaments, there will be a general flow of the surrounding air inwards towards the bottom of the rising air. Conversely, descending vortices or filaments will spread outwards near the ground and there will consequently be a flow of air away from the descending currents. It follows, therefore, that in the long run there will be a predominating tendency for pilot balloons to be carried away from descending currents and into ascending currents, and that two theodolite pilot-balloon ascents tend to exaggerate the frequency of ascending currents at the expense of the descending currents.

In the second place, it is important to remember that every ascending portion of air has its counterpart in an adjoining descending current. A pilot-balloon ascent tends to mask these descending currents; but they exist all the same, as is shown sometimes by a pilot-balloon, filled to rise at 500 feet per minute, rising less than 400 feet in the first minute, under conditions in which one knows that there is strong convection present. The descending currents are probably not so vigorous as the ascending, but they probably diminish appreciably the effect of the ascending currents.

It is therefore to be expected that if a pilot-balloon ascent indicates a mean standing velocity of the air of 5 feet per second up to the vertex of a trajectory, the over-ranging will be less than the calculated effect of a vertical wind velocity of this magnitude. For, in the first place, the pilot-balloon tends to select the strongest ascending currents, whereas the shell does not, and, in the second place, the shell is subject to descending currents, which a pilot-balloon avoids, but which tend to diminish the effect of the ascending currents upon the range.

Whilst, therefore, the effect of strong convection upon the shooting of a gun will be to decrease the accuracy of the shooting and to cause over-ranging, the increase in range will not be so great as it might appear to be at first sight.

Porton, January, 1922. NELSON K. JOHNSON.

Weather Lore.

THE following letter has reached me from Commander Brooke Smith :—

> "I have just seen your note "Weather Lore" in the February *Meteorological Magazine*. I quite believe that what the Captain of the *Jupiter* told you may often be correct.
>
> We often say at sea that weather changes when coming on soundings (*i.e.*, crossing the 100-fathom line), as, for example, when homeward bound, approaching Ushant.
>
> I have my own ideas about this, and if you examined the sea-surface temperatures to seaward and also on soundings, I think that you might perhaps be able to show us that sometimes these sayings are worth a good deal of consideration.
>
> If you could explain the physical causes in simple straightforward language, I feel sure the seafarers would benefit.
>
> In many estuaries where there are sand or mud flats we notice variations of wind with tide; the explanation seems simple in these cases, but I should not like to attempt to give one to anyone else but a sailor, as my language would be misunderstood.
>
> These are both questions which, if answered, would give us really useful information; for the latter, the Bristol Channel above Minehead might give you a good field."

L. A. BROOKE SMITH.

Mrs. T. Story-Maskelyne writes from Basset Down, giving local variants of rhymes about February and Candlemas. It is more difficult on land to get the kind of local saw that I was referring to than it is at sea, because it involves that comparison of one place with another which comes within the experience of seamen as a matter of course, but not of landsmen unless they are carriers or railwaymen. The helm-wind is one of the well recognised local occurrences of the type I was thinking of. People living in Edinburgh are apt to think it a peculiarly windy place, and visitors might agree, but why should it be? Leith, I believe, is not.

NAPIER SHAW.

School of Meteorology, March 6th, 1922.

Distribution of Hoar Frost on Furrowed Grassland.

I NOTICED on Monday night, February 13th, a curious distribution of hoar frost on grass. I was crossing The Meadows, a large open space in Edinburgh, somewhat late in the evening. The path along which I was walking has grass on both sides of it, and the hoar frost, instead of being general over the grass, was in bands almost at right angles to the direction of the wind. On closer inspection it was seen that these bands of hoar frost were on the leeward slopes of small ridges or undulations. The wind at the time was from west-by-north, force about 3 or 4, so that on looking along the grass towards the east hardly any hoar frost was to be observed, while looking in the opposite direction irregular bands of hoar frost running mainly from north to south were distinctly noticeable. The night was a brilliant one, dry, with a temperature of about 30° F. Later in the night the air became much more humid and next morning the hoar frost was general and very heavy.

J. E. BELASCO.

Meteorological Office, Edinburgh, 16th February, 1922.

Units for Meteorological Work.

MAY I now make one or two remarks about the correspondence in the *Meteorological Magazine* on units of measurement? I read the letters carefully, including the "Case for Modern Units" by Mr. Whipple. The cases presented by barometrical readings and those for rainfall present such different conditions that they need separate consideration and treatment. Pressure records are complicated by corrections necessary for temperature latitude and height above sea-level. A good case can be made out, I consider, for the use of millibars, but rainfall measurement is simple; no corrections are required, and the use of millimetres, instead of simplifying, makes the records more obscure. Except for international comparison, which is comparatively unimportant in the case of rainfall, all the advantages appear to lie with the use of inches.

I venture to hope that the present dual system, which is annoying and confusing, will be terminated at an early date. For example, the frontispiece to *British Rainfall,* 1920, which must have involved great labour to prepare, is quite spoiled by this confusion. I turned from it at once with disgust.

I consider the adoption of the new unit will sadly handicap the value and popularity of rainfall observation.

S. F. HURNARD.

Hill House, Lexden, Colchester, January 11th, 1922.

NOTES AND QUERIES.

Ball Lightning.

An interesting description of ball-lightning has been received from Captain J. H. W. Morgan, late of the Indian Army. In June, 1898, Captain Morgan and a friend were walking from Kailana in the North-west Himalayas towards Mussoorie. When they were at an elevation of 7,500 ft. they observed a violent monsoon thunderstorm driving up from the low country. Shortly after nightfall they reached Lakhwar, which is about 4,000 ft. up. The storm had passed over the district, although the lightning could still be seen in the distance, leaving dense masses of mist and cloud, while the air was very hot, still, and oppressive. In the dense mist a succession of pale, round lights were seen floating in the direction of the storm; each was watched till it was out of sight. The balls appeared about 6 ins. in diameter, but the edges were not well-defined. The colour was similar to that of a firefly, but the behaviour of the lights proved that they were not fireflies; moreover, no fireflies were found in the locality.

Another account of ball-lightning is given in *Nature* of January 26th by Mr. A. P. Chattock, of Bristol University. The ball was observed by the Misses Pitman at 8 p.m. on August 17th, 1921, at Eastbourne. The evening was still and not very hot, but heavy rain was falling. No thunder was heard, although a thunderstorm was reported from London at the same time. As one of the ladies took up a knife from the table a ball of light was seen to flash past it on to the table, when it disappeared with a spitting sound, leaving no mark or trace. The ball itself was about the size of a pea, and with the light encircling it about the size of a golf ball. In colour it was white, and intensely bright, and it travelled the nine inches from knife to cloth in a " flash of time."

A New Method of obtaining the Velocity of Upper Winds.

During the war, one of the most accurate methods of obtaining the upper wind at considerable heights consisted in watching, in a horizontal mirror, the smoke from a shell-burst. This method was itself an application of the ordinary reflecting nephoscope. The difference between a nephoscope observation and a shell-burst observation was that, in the latter case, the height of the shell-burst was known with considerable accuracy, whereas in the case of the cloud, the height could only be roughly guessed. The use of mirrors for observations of shell bursts was extended by Colonel A. V. Hill, who introduced observations with two mirrors at the ends of a base line to determine the height as well as the horizontal motion. The mirrors used for this purpose are now commonly called Hill's Mirrors.*

It times of peace it is not permissible, in most places, to arrange shell-bursts. Consequently mirrors have gone out of fashion and upper winds are determined almost exclusively by means of pilot balloon observations. The pilot balloon method is likely to remain the standard for some time on account of its relative cheapness. The method, however, suffers from the disadvantage that observations at considerable heights are impracticable with high winds in the lower layers of the atmosphere, or with detached clouds.

Aeroplanes have recently been used for making smoke rings at considerable heights, and it occurred to me that smoke emitted from aeroplanes might be used instead of the smoke from as hell-burst, for observations of upper wind. An opportunity recently presented itself for the trial of the method, which proved successful. The experiments were made by Mr. C. D. Stewart. The "smoke" was produced by using a one-pound tin of Stannic Chloride. The tin has a wire soldered through the base and another to the lid. The wire through the base is fixed to the under-carriage of the aeroplane and the wire through the lid is passed up to the observer's seat. At a pre-determined height, the observer pulls the lid off the tin. The Stannic Chloride is quickly dispersed and a fine cloud produced which is easy to follow in the mirror. By using two or more tins, the wind at a series of pre-determined heights can be obtained quickly and accurately.

In practice the method can only be used when areoplanes are making ascents for other purposes, as it would usually be too expensive to employ an aeroplane specially for this purpose.

E. GOLD.

Frequency of Fog in the English Channel.

SOME information as to the frequency of fog at different parts of the coast may be gathered from the records kept by the keepers of lightships and lighthouses giving the hours during which the fog-syrens are sounded. The following summary is derived from statistics supplied by Trinity House to the

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[* Hill's mirrors are illustrated in the second edition of *The Computer's Handbook,* Sec. II., p. 32. It is understood that the details of the apparatus were worked out by Colonel Hill in collaboration with Sir Horace Darwin.—ED. M. M.]

Meteorological Office and has been prepared in the Marine Division. It refers to the twelve years 1908, 1910–20.

Station.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Y.
	Percentage Duration in Hours.												
Longships	4·4	5·2	3·6	4·6	11·3	5·7	6·7	5·4	5·6	5·5	5·0	3·6	5·5
St. Catherine's Point	3·0	4·0	2·7	1·7	6·7	3·6	1·1	1·6	1·0	0·5	1·0	1·5	2·4

The "Longships" Light-vessel is stationed off the coast of Cornwall, 2 miles west of Land's End. St. Catherine's Point Lighthouse is on the Isle of Wight. It will be seen that the syren is used twice as frequently at the light-vessel. In both positions the sea-fog is most common in May.

A Tragedy of the Alps.

It is reported in the Press that the keeper of the meteorological observatory on Mount Saentis, and his wife, were found murdered on February 25th. The station is situated on the summit of the mountain, 8,215 feet above sea-level, in the Canton of Appenzell, south of Lake Constance. When the authorities failed to get an answer to telephone calls, it was thought that the lines had been broken down by the recent heavy snowfalls, and it was not until a porter visited the station with supplies that the crime was discovered.

The observations made at this station are among those distributed daily by wireless from the Eiffel Tower and they have proved of great use in the preparation of forecasts by the Meteorological Office.

The "Field" Forecasts.

The enterprise of the *Field* newspaper in publishing weather forecasts covering a week in advance has been the subject of much favourable comment during the past year. It is announced that subscribers are to receive in future a table which will cover twenty days in advance. The experiment will be watched with interest, even by the meteorologists who think that the methods which appear to be adopted are inadequate for the purpose.

Meteorological Stations.

Newport, Isle of Wight.—A climatological station has been set up by Mr. F. Morey of Wolverton, The Mall, Newport, and his observations are being published in the *Monthly Weather Report* as from January, 1922.

The Control of Lightning.

THE "lightning-rod man" has been long a familiar figure in American literature and certainly there has always been a wide scope for his activities. In Ontario alone, loss from fires caused by lightning has been estimated at something like half-a-million dollars a month. The lightning-rod man fell into disrepute, however, because he had not sufficient knowledge of lightning control and because his rods were not properly grounded and fixed. The Fire Prevention League of Ontario, realising the seriousness of this loss from fire, especially in agricultural and timbered districts, drafted a Lightning Rod Act which was passed by the Ontario Legislature to take effect on January 1st of this year. The Act provides for the use of standardised rods and gives detailed instruction as to their construction and installation. The League, which has been in existence since 1919, has already been successful in reducing substantially the annual loss from fire, and it is to be hoped that the Lightning Rod Act will prove effective in protecting homesteads and crops.

The Forecasting of Drought.

WRITING with reference to Mr. Brooks's article* entitled "Could the Drought of 1921 have been forecasted?" Mr. H. A. Rogers points out that such developments of meteorology would fulfil the hopes of Admiral Fitzroy, and would prove of the greatest benefit to agriculture and other industries. Mr. Rogers's experience as a meteorological observer goes back to 1856; he saw snow on the Mendips in June of that year, and was told that ice had come unusually far south in the Atlantic.

Standardized Rain Gauges.

MESSRS. CASELLA & CO. have issued a revised price list of rain gauges, and we are glad to see that the multiplicity of patterns which formerly confused the mind of the uninstructed purchaser has given way to a few well-designed and standardized types. One or two of those figured are unsuitable for general use, and a distinct step in the right direction is made by the insertion of a slip showing the gauges which are approved by the Meteorological Office. The statement that the "Dial gauge" is "accurate enough for the majority of private observers" is, however, one which we cannot endorse. No observer wishes to keep inaccurate records, and experience shows that after use for a year or two the indicators of dial gauges are seldom to be trusted.

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* *Meteorological Magazine*, Sept. 1921, p. 211.

Eighteenth Century Meteorology.

THREE volumes of eighteenth-century meteorological records, in manuscript, have been lent to the Library of the Meteorological Office by the courtesy of the Provost and Fellows of Lancing College.

The first volume, by J. Whiston, gives elaborate descriptions of the weather at places in Worcestershire and Hereford for each day of 1703. The second, apparently by his grandson, gives general descriptions of the weather of each year from 1733 to 1794 at Lyndon, Rutland, while the third is a meteorological diary of observations from 1748 to 1763.

It is hoped that some enthusiast will be found to undertake the preparation of a summary of the records.

Philippine Folk-Lore.

THE New York *Literary Digest* of February 18th, 1922, contains a notice of Mr. Charles H. Meeker's work on the superstitions and folk-lore of the Philippines. Some of his collections have been published recently in the *Oklahoma County News*. The following sayings may be new to readers :—

> " Bathing a cat causes rain."
>
> " If you wish it to rain, put a lighted candle in a new pot, tie a string around the pot and pull it on the river like a small boat and a heavy rain will soon fall."
>
> " Don't carry monkeys or cats with you on an ocean trip, because they will cause the wind to blow hard."
>
> " When a sea-turtle comes ashore, it causes cool water."

Review.

Handbook of Meteorology : a Manual for Co-operative Observers and Students. By Jacques W. Redway. $8\frac{1}{2} \times 5\frac{1}{4}$. v + 294 pp. New York : Wiley and Sons. London : Chapman and Hall. 1921. 24*s*. net.

THE author of this handbook dates his preface from the Meteorological Laboratory, Mount Vernon, New York, and states that it is written " for the use of co-operative observers " and for the instruction of students in meteorology. Part I. contains a general account of the science, whilst Part II. deals with instruments and the standard methods of observation.

The general descriptive matter of Part I. is written in a popular way, hardly suitable, it might be thought, for the serious student. General principles are not clearly set out (for example, there is no explicit statement of Buys Ballot's Law), and algebra is taboo. There is only a single specimen of an isochronous chart, though room is found for five pages of folklore. In passing, two samples of folklore may be quoted; a gruesome one—" When the locks turn damp in the scalp-house, most surely it will rain," and a " howler "—" A lunar halo indicates rain; the larger the halo the sooner may rain be expected."

The interest of the book to the English meteorologist is mainly in Part II., as the difference in equipment and practice as between English and American stations can be studied so readily. Take the thermometer screen,—our practice is to have the screen made with double louvres and to place it in an exposed position. Mr. Redway says that there can be no objection to placing the shelter in the shade of a tree, but on the other hand the front of his screen is apparently merely wire gauze. His advice is surely a counsel of perfection: " In locating a place for a shelter, it is a good plan to use a second thermometer in various positions, checking and comparing maxima and minima. Reflection and absorption sometimes bring about unexpected results. Observers with experience are alert to these possibilities; the inexperienced observer must learn them."

We are still accustomed to use dry and wet bulb thermometers without special ventilation. It is not clear from Mr. Redway's description how far the stationary hygrometer is used in America, but we learn that " the whirling table is now generally employed where systematic observations are made." Even with such apparatus, difficulties are not eliminated entirely, for " when the moisture is close to saturation two or three successive determinations may be necessary for a satisfactory result," and likewise when humidity is low the differences in several determinations " may be considerable."

As for the maximum thermometer the American observer is recommended to have the stem sloping with the bulb end uppermost, to avoid " retracting " of the column; the English observer has the stem sloping the other way to avoid the risk of the column running away from the constriction.

The American type of rain gauge which is provided with a narrow inner can has advantages. The quantity of rainfall is measured by dipping a stick in the can and seeing how far up it is wetted, and all risk of spilling any water in decanting it thereby avoided. Much is also to be learned from America as to the measurements of snow. Apparently accumulations of snow 30 feet thick have been gauged in the Sierra Nevada ranges.

Enough has been said to indicate that Mr. Redway's book is a valuable addition to our works of reference, even though it is not to be recommended to the English observer for everyday use.

News in Brief.

On March 8th a deep depression rapidly crossed southern England in a north-easterly direction, causing strong gales in the English Channel. A gust of 108 miles per hour was recorded at Scilly at 4 a.m. Only once before has a gust approaching this been reported to the Meteorological Office, viz., 110 miles per hour at Quilty, Co. Clare, on January 27th, 1920. The thermometer-screens at Cattewater, Pendennis Castle and Beachy Head were overthrown during the gale, and at Lympne Aerodrome an ex-army trailer used as an observation hut was blown 15 yards away and overturned.

Shoeburyness.—On Friday evening, January 6th, a Meteorological Office staff-dinner was held at Queen's Hotel, Westcliff-on-Sea. Mr. C. E. Britton was in the chair, and there were fourteen present, the guest of the evening being Capt. D. Brunt, Superintendent of the Army Services Division. It is hoped to make the dinner an annual institution.

The National Research Council at Washington have issued a Bulletin (Vol. 2, Part 7, No. 15) containing a list of the seismologic stations of the world, compiled by Mr. H. O. Wood.

The Times of January 25th states that an advertising toy-balloon sent up from Thrapston, Northants, during a recent shopping week, was picked up at Gussola, near Cremona, in Italy. It is hoped that further details will be obtained.

Mr. S. Single, of 17, Kensington Palace Mansions, S.W. 7, wishes to dispose of a Stevenson screen and a set of tested thermometers. Any reader wishing to purchase them should communicate with Mr. Single.

The Weather of February 1922.

The pressure distribution over the Atlantic, westward of Ireland, was almost continuously cyclonic throughout the month, whilst the Scandinavian regions and central Europe were largely dominated by anticyclonic conditions. Depressions were almost wholly confined to tracks northward, and north-eastward of the British Isles, with troughs of low pressure extending over our Islands. In western Europe and Iceland, temperature was generally high for the period of the year, but frost of exceptional severity prevailed over central Europe and round the Baltic, the state of the ice-bound sea restricting all shipping movements.

On the 1st a ridge of high pressure moving eastwards in the rear of a shallow low pressure trough was succeeded by a depression which advanced quickly from the west. Warm air from the Atlantic temporarily displaced cold air from the Continent on the 2nd, sharp thunderstorms occurring over southern England during the afternoon. On the 4th a low pressure trough extended from Iceland to central Europe with south-easterly to easterly winds and a low temperature on its north-east edge, and westerly to north-westerly winds with relatively warm air on its south-west edge. The wedge of cold air advanced slowly westwards causing a day with continuous snow and sleet in eastern England, and with a maximum temperature of only 30° F. at Cranwell, Gorleston and Pulham. A thunderstorm occurred in the Channel Isles at 13 h. Precipitation over England varied between 3 and 5 mm., but Frankfort reported 34 mm., Zurich 17 mm. and Bayonne 21 mm. Conditions improved on the 5th, but temperature remained low over eastern England, with maxima around the freezing point and snow showers locally. Temperature was as high as 49° F. in Iceland, whilst Scandinavia, the Netherlands, and eastern Europe continued in the grip of severe frost. Hard frost occurred on the night of the 5th-6th, Benson reporting a shade minimum of 19° F., South Farnborough 16° F. (9° on grass), and Cranwell 15° F. (8° on grass), whilst –29° F. was experienced at Haparanda, and –13° F. at Saerna and Memel. Over Iceland a very deep depression was indicated with pressure below 964 mb. Low pressure was maintained from the Azores to Spitzbergen with comparatively mild conditions, the eastern half of Britain continuing under the influence of the cold continental air supply. Upper air temperatures on the 9th and 10th showed that the cold area was comparatively shallow. At Andover on the 9th there was an inversion of 10° F. at 1,000 feet, and on the 10th, of 15° F. at the same altitude. Up to 20,000 feet at Andover, South Farnborough and Leuchars (Fifeshire) there was an excess at all levels varying between 10° F. and 20° F. From the 10th to the 13th very bright weather was experienced over the southern districts, with daily sunshine records of between seven and eight hours. On the 12th a decided fall of pressure set in over western Europe, and with the establishment of a general southerly to south-westerly wind current, temperature rose. In the Netherlands and northern France the rise varied between 9° F. and 18° F. A centre of low pressure passed from Greenland to the south-east of Spitzbergen, high pressure at the Azores tending to spread north-eastwards. Associated with the passage of an anticyclonic ridge frost again occurred over the inland districts of England on the night of the 13th–14th, being quickly followed by the extension of an Atlantic " low " with rain and milder conditions on the succeeding day.

Cyclonic conditions became general over northern and western Europe, whilst an anticyclonic belt stretched from the Azores across Spain and Italy to southern Russia. On the 18th, in the rear of a secondary depression, which developed a definite centre over the northern part of the North Sea, a cold north-west wind-current set in with a marked temperature fall, a fine day with sunshine in excess of eight hours occurring over the southern districts. On the morning of the 19th, a depression of unusual depth was approaching rapidly from the Atlantic, pressure in the south of Iceland being down to the remarkably low level of 937 mb. The depression subsequently decreased in intensity, but remained almost stationary for several days in the Icelandic region, secondaries associated with it crossing the British Isles. Much hail, with sleet, snow and westerly gales were reported from the Atlantic, a temporarily colder air supply being in evidence on the western coasts. Thunderstorms or lightning, and hail occurred at the western seaboard stations on the 21st.

The Azores anticyclone subsequently advanced towards Spain, and a flow of warm air set in from the Azores region, becoming general over the British Isles on the 23rd. From the 23rd to the 25th maximum temperatures generally exceeded 55° F., reaching 60° F. in London and at Chester, 58° F. at Banff on the 24th, and 62° F. on the North-Wales coasts on the 25th. Secondary depressions maintained very variable weather to the close of the month, heavy falls of rain occurring in the western districts. At Valencia Observatory, 21 mm. fell on the 24th, and at Stornoway 18 mm. At Lerwick, Malin and Blacksod, 14 mm. were reported on the 25th, 20 mm. at Valencia. On the 27th, Lerwick again had 14 mm., and Scilly 22 mm. General but less heavy falls occurred further east with alternate bright and rainy days. Strong winds were general with gales in the English Channel, South Wales, and along the Atlantic seaboard, temperature continuing above the normal. From the 26th to the 28th thunderstorms, with local hail, were of daily occurrence at the western seaboard stations. Conditions in the Mediterranean area were mainly cyclonic throughout the month. Limassol reported a rainfall of 52 mm on the 4th. On the 6th, a deep depression occupied the region south-west of Italy and the spreading southward of the central-European anticyclone caused a steep gradient over northern Italy with a north-easterly gale at Pesaro on the 7th. Snow fell at Rome, and a temperature of 28° F. was reported from Florence on the morning of the 8th. Temperature was low at times on the north African coast.

Apart from much low cloud at times and local fog on the 1st and the 26th, visibility was mainly good to very good.

S. C. R.

A remarkable fall of temperature occurred over nearly the whole of France on the 5th. Thermometer readings as low as 10·4° F. at Paris and — 5° F. at Strasbourg were recorded.

In the early part of the month central and southern Italy were suffering from continued cold weather. Snow fell in Rome on the morning of the 8th, an event which had not occurred for several years. The cold was severe and heavy snowfalls so widely distributed that telephonic communication was deranged all over the country, while railway traffic was delayed and in some parts entirely disorganised.

The severe cold brought packs of wolves down from the mountains along the Mediterranean coast of France and north Italy, and several villages have had to undertake protective measures. Numerous wolves have been seen on the outskirts of the town of Saint-Maximin, 25 miles inland from Toulon, an occurrence without precedent in living memory.

On the night of the 7th, 60° of frost were registered at St. Moritz and the weather has been very cold throughout Switzerland, with considerable snowfalls. An avalanche blocked the road and railway running by the shore of the Lake of Brienz on the 4th and extended 300 feet into the lake. The western part of Lake Neuchatel was covered with ice 8 inches thick at the middle of the month, and a week previously it was possible to walk from the island of Reichenau in the western part of Lake Constance to Constance, a distance of about four miles.

The whole of south-eastern Europe experienced a degree of cold such as has not been known for several years, and exceptionally heavy snowfalls occurred over Austria, Herzegovina, and Southern Hungary. Railway traffic was frequently blocked and on the 9th, the town of Sarajevo was completely isolated. Much suffering has been caused in Vienna. The Danube froze near Mohacz. In parts of Hungary the snowdrifts lay yards deep and trains and even small houses were completely buried.

In Christiania Fjord, the Cattegat and western Baltic generally, the ice has been so extensive that many ships were icebound off the coasts, in some cases for a fortnight or more. One ship had to be supplied with food by aeroplane. Towards the end of the month conditions were somewhat better, but large ice-breakers were still at work in Christiania Fjord where twenty steamers were held in the ice. On the 27th there was open water between Malmö and Copenhagen.

Several large ships suffered damage in the Atlantic early in the month, having encountered violent storms and gales.

On the 23rd, a great storm of sleet, rain and wind paralysed all transportation services depending on power from Niagara, and

(*Continued on* p. 60.)

Rainfall Table for February 1922.

STATION.	COUNTY.	Aver. 1881—1915.	1922.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	1·67	2·20	56	132	·34	2, 21	15
Tenterden (View Tower)	*Kent*	1·97	2·20	56	112	·31	26	14
Arundel (Patching Farm)	*Sussex*	2·21	3·36	85	152	·64	27	16
Fordingbridge (Oaklands)	*Hampshire*	2·49	3·26	83	131	·44	2	21
Oxford (Magdalen College)	*Oxfordshire*	1·58	2·37	60	150	·35	27	16
Wellingborough (Swanspool)	*Northampton*	1·61	2·12	54	132	·42	28	16
Hawkedon Rectory	*Suffolk*	1·52	1·68	43	110	·44	2	13
Norwich (Eaton)	*Norfolk*	1·64	2·70	69	165	·80	3	14
Launceston (Polapit Tamar)	*Devon*	3·21	4·37	111	136	·64	28	18
Sidmouth (Sidmount)	„	2·50	2·60	66	104	·45	28	19
Ross (County Observatory)	*Herefordshire*	2·01	3·19	81	159	·81	28	19
Church Stretton (Wolstaston)	*Shropshire*	2·20	4·76	121	216	·85	27	17
Boston (Black Sluice)	*Lincoln*	1·46	2·46	63	168	·75	28	13
Worksop (Hodsock Priory)	*Nottingham*	1·54	2·65	67	172	·55	3	17
Mickleover (Clyd House)	*Derbyshire*	1·65	3·02	77	183	·61	28	16
Southport (Hesketh Park)	*Lancashire*	2·10	3·43	87	163	·70	2	18
Harrogate (Harlow Moor Ob.)	*York, W. R.*	2·09	3·28	83	157	·58	3	16
Hull (Pearson Park)	„ *E. R.*	1·66	2·84	72	171	·55	2	18
Newcastle (Town Moor)	*North'land*	1·59	2·31	59	145	·59	3	13
Borrowdale (Seathwaite)	*Cumberland*	11·87	9·15	232	77	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	3·00	4·73	120	158	·77	27	20
Haverfordwest (Gram. Sch.)	*Pembroke*	3·48	5·07	129	146	·77	27	19
Aberystwyth (Gogerddan)	*Cardigan*	3·17	5·34	136	168	·75	27	15
Llandudno	*Carnarvon*	2·08	3·19	81	153	·55	3	16
Dumfries (Cargen)	*Kirkcudbrt.*	3·88	3·82	97	98	·59	2	22
Marchmont House	*Berwick*	2·08	2·96	75	142	·57	17	19
Girvan (Pinmore)	*Ayr*	4·27	4·90	125	115	·60	20	23
Glasgow (Queen's Park)	*Renfrew*	2·94	3·34	85	114	·45	2	21
Islay (Eallabus)	*Argyll*	4·19	7·17	182	171	·75	17	25
Mull (Quinish)	„	4·74	8·11	206	170	1·12	21	24
Loch Dhu	*Perth*	7·45	9·50	241	127	1·20	25	22
Dundee (Eastern Necropolis)	*Forfar*	1·88	2·47	63	131	·68	3	22
Braemar (Bank)	*Aberdeen*	2·85	3·15	80	111	·74	25	17
Aberdeen (Cranford)	„	2·32	2·41	61	104	·45	17	15
Gordon Castle	*Moray*	1·92	2·32	59	121	·69	17	16
Fort William (Atholl Bank)	*Inverness*	7·53	10·81	275	143	2·75	24	24
Alness (Ardross Castle)	*Ross*	3·30	4·00	102	121	·57	28	19
Loch Torridon (Bendamph)	„	7·90	11·95	303	151	2·20	24	23
Stornoway	„	4·46	5·36	136	120	·72	24	23
Loch More (Achfary)	*Sutherland*	6·60	6·05	154	92	·65	13	23
Wick	*Caithness*	2·27	1·79	46	79	·37	25	19
Glanmire (Lota Lodge)	*Cork*	3·95	4·40	112	111	·75	7	22
Killarney (District Asylum)	*Kerry*	5·22	7·44	199	143	·90	25	25
Waterford (Brook Lodge)	*Waterford*	3·26	3·00	76	92	·68	1	18
Nenagh (Castle Lough)	*Tipperary*	3·12	6·12	155	196	·73	2	23
Ennistymon House	*Clare*	3·40	6·28	159	185	·72	24	23
Gorey (Courtown House)	*Wexford*	2·81	2·01	51	72	·43	1	19
Abbey Leix (Blandsfort)	*Queen's Co.*	2·68	3·58	91	133	·64	2	20
Dublin (FitzWilliam Square)	*Dublin*	1·89	1·34	34	71	·16	3	17
Mullingar (Belvedere)	*Westmeath*	2·78	3·40	86	122	·53	2	21
Crossmolina (Enniscoe)	*Mayo*	4·46	7·27	185	163	·86	24	24
Collooney (Markree Obsy.)	*Sligo*	3·51	6·08	154	173	·84	24	23
Seaforde	*Down*	3·05	4·02	102	132	·59	1	21
Ballymena (Harryville)	*Antrim*	3·24	4·78	121	148	·81	3	23
Omagh (Edenfel)	*Tyrone*	2·98	5·49	139	184	·90	25	22
Letterkenny Asylum	*Donegal*	3·71	5·15	131	139	·78	24	24

Supplementary Rainfall, February 1922.

Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	..	..
"	Sevenoaks, Speldhurst	2·64	67
"	Hailsham Vicarage	2·63	67
"	Totland Bay, Aston Ho.	2·36	60
"	Ashley, Old Manor Ho.	2·82	72
"	Grayshott	3·45	87
"	Ufton Nervet	2·71	69
III.	Harrow Weald, Hill Ho.	2·63	67
"	Pitsford, Sedgebrook	2·08	53
"	Chatteris, The Priory.	1·56	40
IV.	Elsenham, Gaunts End	1·93	49
"	Lexden, Hill House	1·66	42
"	Aylsham, Rippon Hall	2·90	74
"	Swaffham	3·10	79
V.	Devizes, Highclere	3·05	77
"	Weymouth	2·72	69
"	Ashburton, Druid Ho.	7·30	185
"	Cullompton	3·74	95
"	Hartland Abbey	3·74	95
"	Penzance, Morrab Gden.	4·70	119
"	St. Austell, Trevarna.	4·49	114
"	Crewkerne Merefield Ho	3·26	83
VI.	Clifton College	3·81	97
"	Ledbury, Underdown.	2·67	68
"	Shifnal.HattonGrange	2·56	65
"	Ashbourne, Mayfield.	3·19	81
"	Barnt Green, Upwood	2·54	65
"	Blockley, Upton Wold	3·39	86
VII.	Leicester,TownHallSq.	2·22	56
"	Grantham, Saltersford	2·63	67
"	Louth, Westgate	3·00	76
"	Mansfield, West Bank	2·89	73
VIII.	Nantwich, Dorfold Hall	2·83	72
"	Bolton, Queen's Park.	4·13	105
"	Lancaster, Strathspey.	4·05	103
IX.	Wath-upon-Dearne	2·39	61
"	Bradford, Lister Park.	3·47	88
"	West Witton	..	..
"	Scarborough, Scalby	2·73	69
"	Middlesbro', Albert Pk.	1·54	39
"	Mickleton	4·00	102
X.	Bellingham	3·58	91
"	Ilderton, Lilburn	2·32	59
"	Orton	5·80	147
XI.	Llanfrechfa Grange	5·39	137
"	Treherbert,Tyn-y-waun	13·89	353
"	Carmarthen Friary	5·75	146
"	Lampeter, Falcondale	6·73	171
"	Cray Station	8·00	203
"	B'ham W.W.,Tyrmyndd	7·93	201
"	Lake Vyrnwy	8·81	224
"	Llangynhafal, P. Drâw	2·99	76
"	Oakley Quarries	12·39	315
"	Dolgelly, Bryntirion	7·14	181
"	Snowdon, L. Llydaw.	16·90	429
"	Lligwy	3·73	95
XII.	Stoneykirk,ArdwellHo.	4·72	120
"	Carsphairn, Shiel	7·97	202
XII.	Langholm, Drove Rd.	5·68	144
XIII.	Ettrick Manse	5·95	151
"	North Berwick Res.	2·12	54
"	Edinburgh, Royal Ob.	1·86	47
XIV.	Biggar	3·13	79
"	Leadhills	8·48	215
"	Kilmarnock,Agric.Coll.	5·13	130
XV.	Dougarie Lodge	5·07	129
"	Oban	6·62	168
"	Holy Loch, Ardnadam	8·34	212
"	Tiree Cornaigmore	..	..
XVI.	Loch Venachar	5·90	150
"	Glenquey Reservoir	3·80	97
"	Loch Rannoch, Dall	5·25	133
"	Blair Atholl	3·33	85
"	Coupar Angus	2·62	67
"	Montrose Asylum	2·12	54
XVII.	Logie Coldstone, School	1·85	47
"	Fyvie Castle	2·59	66
"	Grantown-on-Spey	1·92	49
XVIII.	Kingussie, Fasnakyle	3·04	77
"	Fort Augustus	6·20	157
"	Loch Quoich, Loan	12·90	328
"	Fortrose	1·41	36
"	Faire-na-Squir	5·60	142
"	Skye, Dunvegan	7·82	199
XIX.	Loch Carron, Plockton.	8·04	204
"	Dornoch, St. Gilbert's.	2·04	52
"	Tongue Manse	1·65	42
XX.	Melvich Schoolhouse	2·20	56
"	Dunmanway Rectory	8·10	206
"	Mitchelstown Castle	4·33	110
"	Gearahameen	12·70	323
"	Darrynane Abbey	5·58	142
"	Cashel, Ballinamona	3·75	91
"	Roscrea, Timoney Pk.	3·44	87
"	Ballybunion	5·27	134
"	Broadford, Hurdlesto'n	6·86	174
XXI.	Kilkenny Castle	2·48	63
"	Rathnew, Clonmannon	1·83	47
"	Hacketstown Rectory	2·58	65
"	Balbriggan, Ardgillan	1·93	49
"	Drogheda	1·75	44
"	Athlone, Twyford	4·24	108
XXII.	Castle Forbes Gdns	4·74	120
"	Ballynahinch Castle	8·03	204
"	Galway Grammar Sch.	5·19	132
XXIII.	Westport House	5·59	142
"	Enniskillen, Portora	4·93	125
"	Armagh Observatory	2·72	69
"	Warrenpoint	3·15	80
"	Belfast, Cave Hill Rd.	4·23	107
"	Glenarm Castle	4·75	121
"	Londonderry, Creggan.	4·92	125
"	Sion Mills	4·72	120
"	Milford, The Manse	5·19	132
"	Narin, Kiltoorish	6·03	153
"	Killybegs, Rockmount	7·40	188

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L. mb.	Diff. from Normal mb.	Max. ° F.	Date	Min. ° F.	Date	Max. ° F.	Min. ° F.	½ max. and min. ° F.	Diff. from Normal ° F.
London, Kew Observatory	1020·3	+3·5	82	8	39	29	69·3	50·2	59·8	+2·7
Gibraltar	1016·0	+0·2	84	5	60	24	78·1	66·0	72·1	−0·5
Malta	1017·1	+1·4	86	22	61	29, 30	81·3	72·3	76·8	+1·5
Sierra Leone	1012·8	+0·2	88	23, 26	71	16, 24, 30	84·4	73·2	78·8	−0·3
Lagos, Nigeria	1013·8	+1·0	87	29	71	5	83·0	74·3	78·7	+0·6
Kaduna, Nigeria	1013·8	+1·0	89	27, 28, 30	62	27	83·7	66·3	75·0	−1·8
Zomba, Nyasaland	1015·4	+1·6	87	29	51	16, 17	79·5	59·3	69·4	+0·3
Salisbury, Rhodesia	1014·5	−0·2	90	25	43	15	80·9	50·6	65·7	−0·5
Cape Town	1020·4	+1·3	83	12	39	3	65·2	49·0	57·1	−0·8
Johannesburg	1019·3	+1·5	83	29	32	10	69·6	47·3	58·5	−0·8
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	..	..	83	29	31	26	72·6	43·3	57·9	−1·2
Calcutta, Alipore Obsy.	1004·0	−0·5	91	8	74	26	88·2	78·6	83·4	+0·4
Bombay	1007·6	−0·4	86	30	74	16	84·0	76·6	80·3	−0·4
Madras	1006·8	+0·3	99	23	73	11	93·1	77·3	85·2	+0·1
Colombo, Ceylon	1010·8	+1·2	89	16	75	2	87·1	77·8	82·5	+1·1
Hong Kong	1009·4	+1·1	91	19	71	24	84·4	76·8	80·6	−0·4
Sandakan	..	..	91	24	71	13	87·7	74·6	81·1	−0·6
Sydney	1018·2	+2·2	84	26	44	1	71·6	52·8	62·2	+3·2
Melbourne	..	..	..	..	..	..	..	..	..	..
Adelaide	1016·5	−1·0	82	28	42	20	68·6	50·3	59·5	+2·5
Perth, Western Australia	1019·0	+1·2	77	3	41	9	65·5	49·2	57·3	−0·9
Coolgardie	1017·3	+0·2	83	4	36	9	72·5	45·7	59·1	+0·5
Brisbane	1019·9	+2·8	80	17	49	21	74·0	56·9	65·5	+0·2
Hobart, Tasmania	1010·8	+0·1	77	7	37	22	62·5	45·8	54·1	+3·3
Wellington, N.Z.	1018·7	+5·2	68	29	31	1	58·5	46·0	52·3	+0·8
Suva, Fiji	1016·4	+2·1	85	22	59	3	83·9	65·2	74·5	0·0
Kingston, Jamaica	1012·9	+0·3	93	7	70	23	89·8	72·4	81·1	−0·4
Grenada, W.I.	1009·5	−2·3	93	7	71	9	86·0	75·3	80·7	+0·5
Toronto	1014·9	−2·6	92	2	43	27	79	57	68	+9
Winnipeg	1009·6	−5·2	91	1	36	30	66	48	57	+3·5
St. John, N.B.	1014·9	−2·6	87	3	38	21	66	50	58	+2
Victoria, B.C.	1016·9	+0·4	69	5, 10	42	29	61	48	54·5	−1

London, Kew Observatory.—Mean speed of wind 5·7 mi/hr; 1 day with thunder heard, 7 days with fog.

Gibraltar.—2 days with thunder heard. From this month mean max. temp. refers to the period 7h. to 21h. and mean min. temp. 21h. to 7h.

Malta.—Wind direction variable; 2 days with thunder heard.

Sierra Leone.—Prevailing wind direction SW; 6 days with thunder heard.

Madras.—6 days with thunder heard.

British Empire, September 1921.

TEMPERATURE		Relative Humidity	Mean Cloud Am'nt	PRECIPITATION				BRIGHT SUNSHINE		STATIONS
Mean Wet Bulb °F.	Absolute Min. on Grass °F.	%	0–10	Amount in.	Amount mm.	Diff. from Normal mm.	Days	Hours per day	Percentage of possible	
55·8	32	70	5·2	1·76	45	− 3	4	5·5	43	London, Kew Observatory
68·6	46	86	4·6	0·28	7	− 29	5	..	..	Gibraltar.
71·9	54	73	3·6	1·29	33	+ 3	4	8·7	70	Malta.
74·7	..	80	7·3	23·35	593	−134	25	..	..	Sierra Leone.
74·4	70	85	9·4	7·94	202	+ 72	16	..	..	Lagos, Nigeria.
69·8	..	86	..	15·28	388	+128	22	..	..	Kaduna, Nigeria.
..	..	89	3·2	0·87	22	+ 13	5	..	..	Zomba, Nyasaland.
54·3	40	45	1·9	0·00	0	− 8	0	..	..	Salisbury, Rhodesia.
53·4	..	70	5·3	2·88	73	+ 16	8	..	..	Cape Town.
46·2	33	53	2·1	1·67	42	+ 18	4	9·5	80	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
47·1	..	53	2·1	0·60	15	− 8	2	..	..	Bloemfontein.
79·7	72	76	8·2	6·35	161	−102	16*	..	..	Calcutta, Alipore Obsy.
76·0	70	80	6·6	13·13	334	+ 59	26*	..	..	Bombay.
76·0	..	75	5·7	2·54	65	− 66	9*	..	..	Madras.
77·2	72	68	7·6	0·94	24	−102	7	..	..	Colombo, Ceylon.
74·3	..	75	6·7	12·10	307	+ 61	12	6·7	55	Hong Kong.
76·2	..	81	..	6·68	170	− 69	18	..	..	Sandakan.
57·5	37	63	3·9	2·82	72	− 2	8	7·5	65	Sydney.
..	..	..	..	..	..	..	..	..	..	Melbourne.
53·0	33	62	4·8	3·07	78	+ 28	14	6·9	59	Adelaide.
54·4	32	70	5·3	5·34	136	+ 51	16	6·5	55	Perth, Western Australia
51·9	33	42	3·3	0·57	14	− 1	5	..	..	Coolgardie.
61·3	44	69	4·5	2·02	51	− 2	15	..	..	Brisbane.
47·8	29	61	6·2	0·96	24	− 30	14	6·1	52	Hobart, Tasmania.
48·4	26	75	5·9	5·76	146	+ 47	10	6·4	54	Wellington, N.Z.
73·3	..	96	..	10·03	255	+ 78	22	..	..	Suva, Fiji.
..	..	80	6·5	5·11	130	+ 26	13	..	..	Kingston, Jamaica.
76·7	..	75	4·1	9·80	249	+ 44	19	..	..	Grenada, W.I.
59·9	38	77	4·3	1·27	32	− 49	9	..	..	Toronto.
52·9	..	94	5·7	3·63	92	+ 42	14	..	..	Winnipeg.
53·7	32	81	5·0	3·79	96	+ 1	10	..	..	St. John, N.B.
50·4	35	78	5·6	2·80	71	+ 20	14	..	..	Victoria, B.C.

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

Colombo, Ceylon.—Prevailing wind direction WSW, mean speed 7·0 mi/hr.

Hong Kong.—Prevailing wind direction E, mean speed 11·3 mi/hr; 6 days with thunder heard.

Perth, W. Australia.—Pressure on 16th lowest on record for September (996·9 mb.).

Wellington, N.Z.—1 day with hail.

Grenada, W.I.—Prevailing wind direction ESE; 2 days with thunder heard. Severe gale passed over the island on 8th.

(*Continued from* p. 55.)

street-car and other communications were suspended in Toronto and other western cities for six hours.

Famine has resulted in certain districts of Kenya (British East Africa) as a result of the general failure of the rains for the past nine months.

The special message from Brazil states that in the north, rainfall was generally scarce, being 69 mm. below normal. In the central district, rainfall was well distributed over the coast and interior, with 47 mm. above normal; but in the south it was very irregular. The temperature of the month was above normal in most places and thunderstorms were unusually frequent between Pernambuco and Rio. The coffee crop has improved considerably, but the crops of cane, tobacco and cotton are not satisfactory.

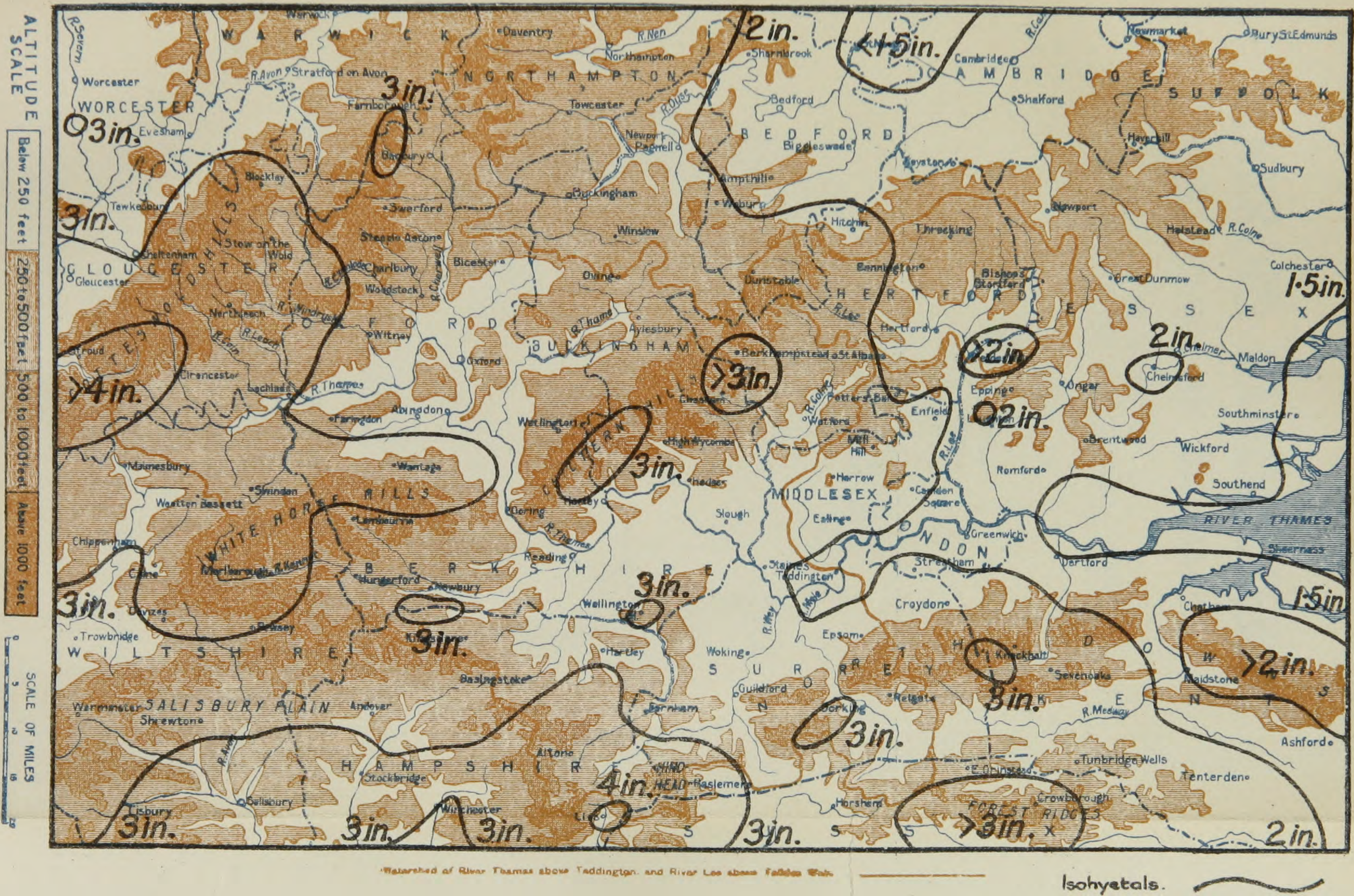
A letter from Mr. R. C. Mossman states that in the Argentine the chief feature of the early days of the month was an anticyclone which appeared from the Pacific on the 9th and caused a severe frost in the Pampas region. Fortunately no damage was done to crops.

THE rainfall of February was above the average nearly everywhere in the British Isles. Less than the average of the period 1881–1915 occurred in the neighbourhood of the English Lake District, the extreme north of Scotland and the south-east of Ireland. The areas with more than 150 per cent. of the average were very widespread, occupying practically the whole of Wales, central England, the north-western half of Ireland and the extreme west of Scotland. More than twice the average occurred in the neighbourhood of Shropshire. Everywhere in the British Isles the rainfall for the month appears to have exceeded 25 mm. (1 in.); less than 50 mm. (2 in.) falling in the south-east of England and locally along the extreme east coasts of England, Scotland and Ireland. More than 250 mm. (10 in.) fell in the mountainous areas, but generally the areas were small. As much as 500 mm. (20 in.) fell on Snowdon. Following on the heavy rain in eastern Scotland during January, the heavy rain towards the end of February, accompanied by the melting of snow on the surrounding hills, caused considerable damage by flooding, especially in the valleys of the Tay and Dee. At Perth the flood was the severest experienced for several years.

The general rainfall for the countries, expressed as a percentage of the average, was: England and Wales, 148; Scotland, 124; Ireland, 138; British Isles, 138.

In London (Camden Square), the mean temperature was 41·0° F., or 1·1° F. above the average; the duration of rainfall, 45·4 hours, and the evaporation, ·31 in.

THAMES VALLEY RAINFALL —— FEBRUARY, 1922.


ALTITUDE SCALE
Below 250 feet
250 to 500 feet
500 to 1000 feet
Above 1000 feet
SCALE OF MILES
0
5
10
15
Watershed of River Thames above Teddington, and River Lee above Feildes Weir.
Isohyetals.
WARWICK
NORTHAMPTON
WORCESTER
GLOUCESTER
OXFORD
BUCKINGHAM
BEDFORD
HERTFORD
CAMBRIDGE
SUFFOLK
ESSEX
MIDDLESEX
LONDON
BERKSHIRE
WILTSHIRE
HAMPSHIRE
SURREY
KENT
SUSSEX
COTSWOLD HILLS
CHILTERN HILLS
WHITE HORSE HILLS
SALISBURY PLAIN
HIND HEAD
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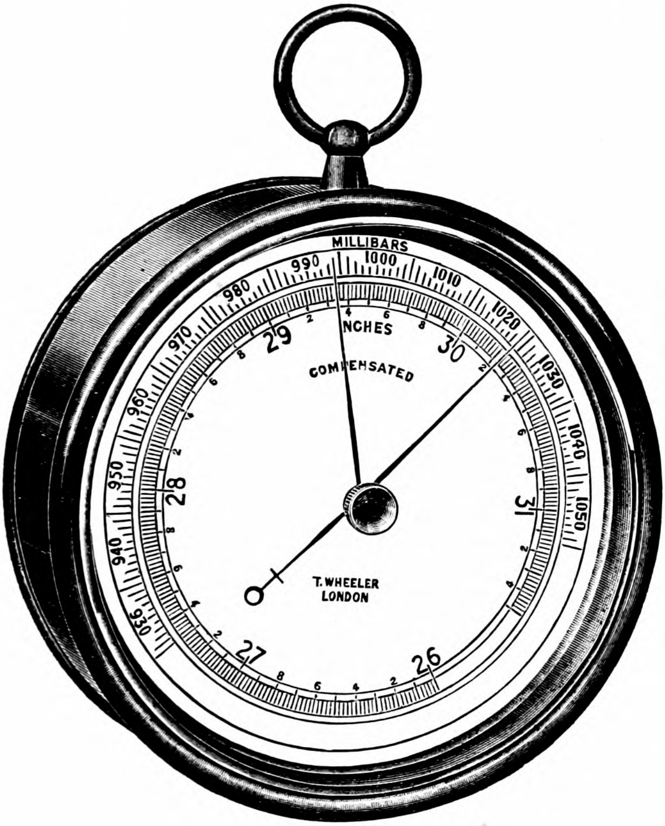
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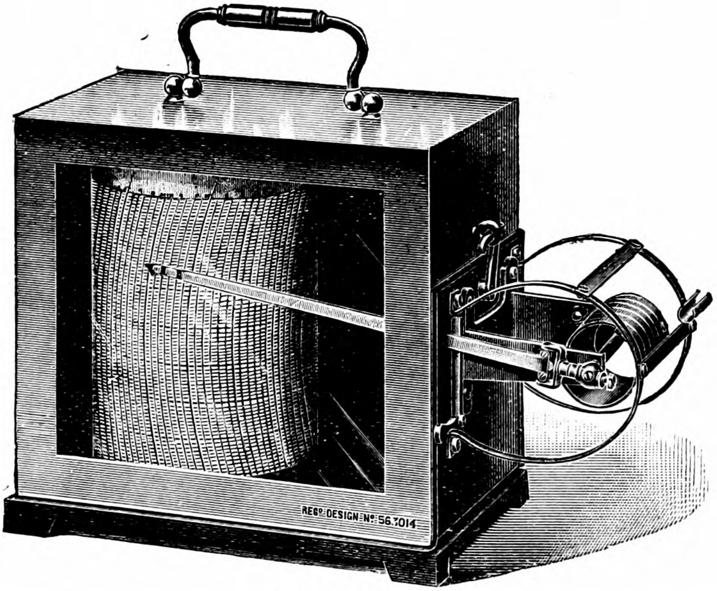

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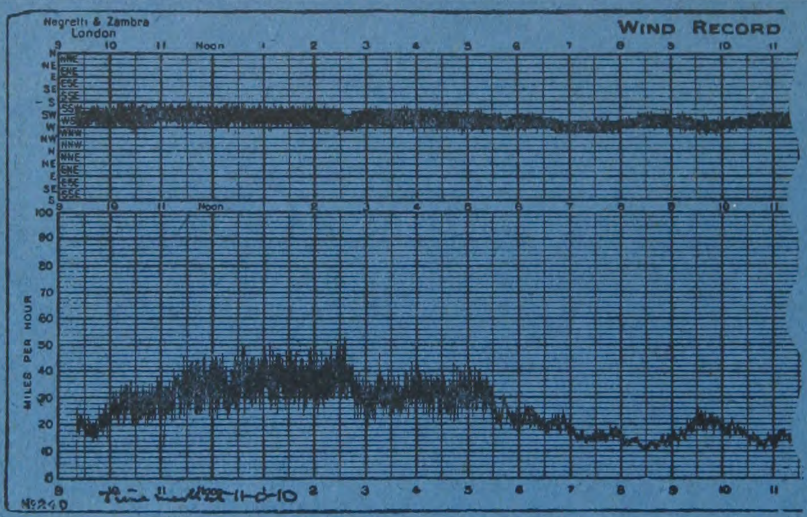

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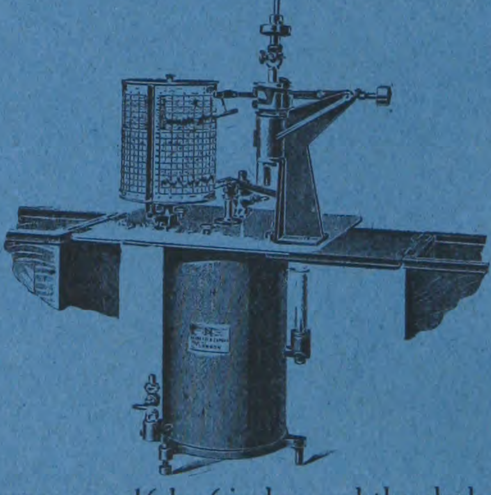

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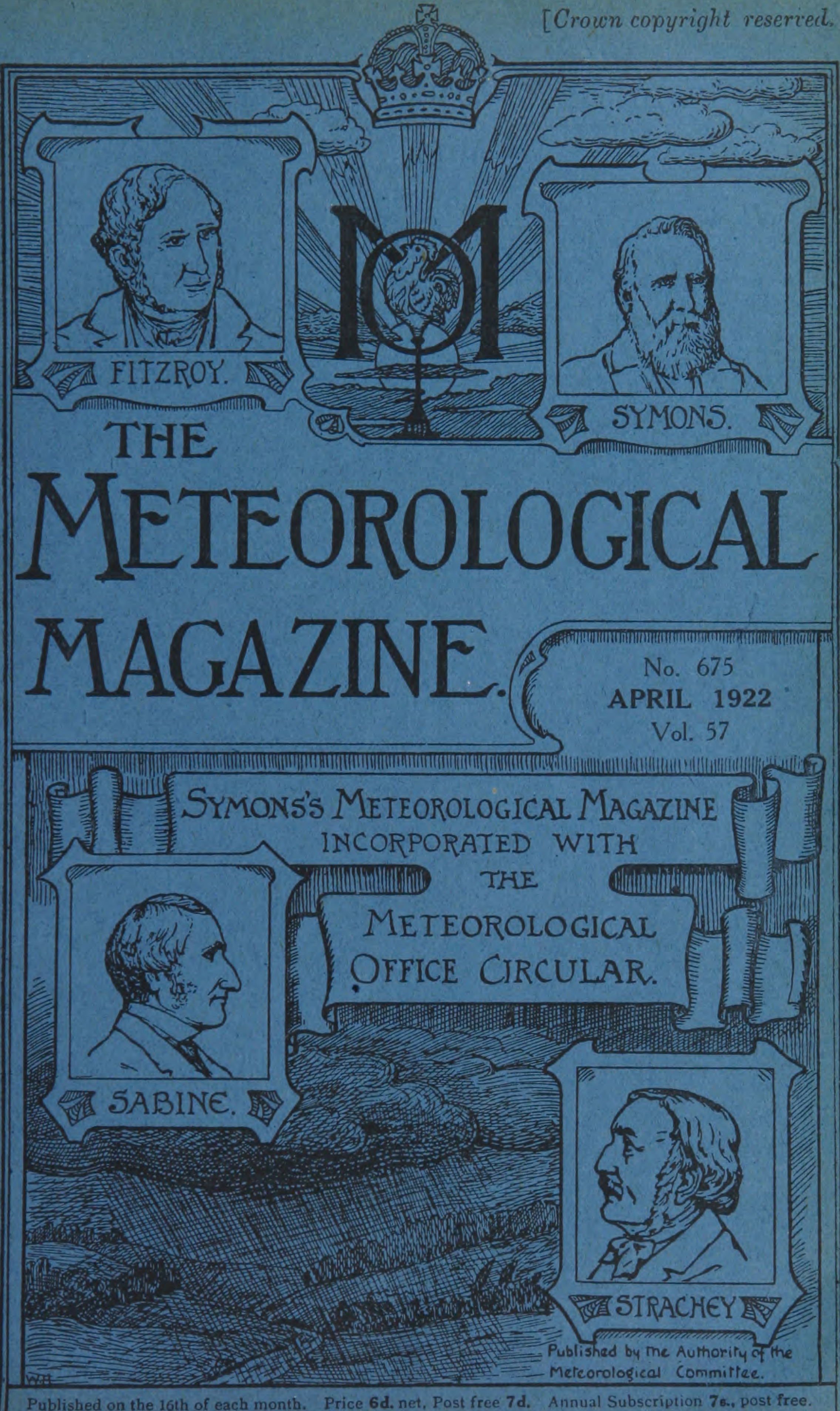

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No. 675
APRIL 1922
Vol. 57

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APRIL 1922.

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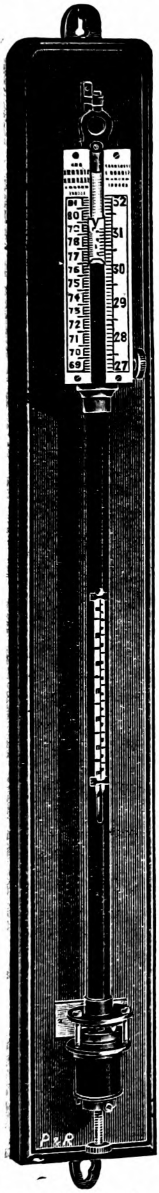

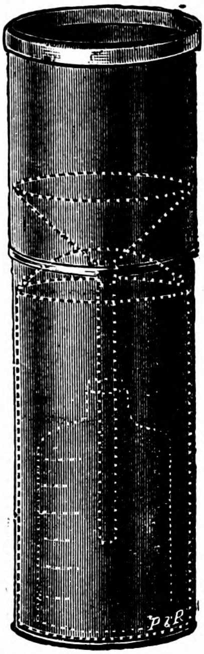

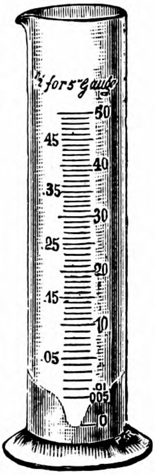
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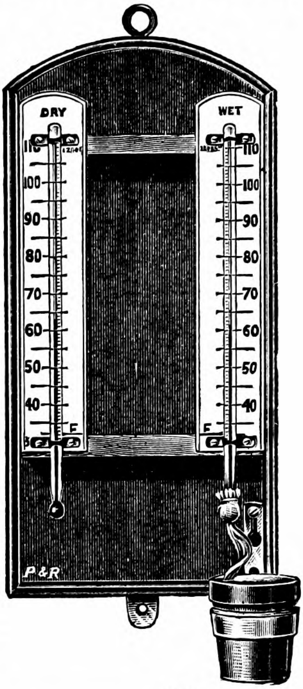

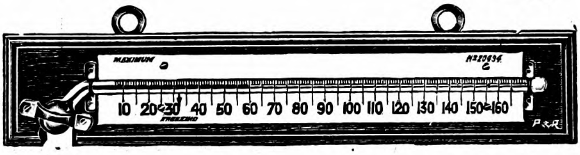
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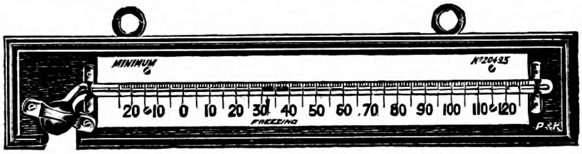
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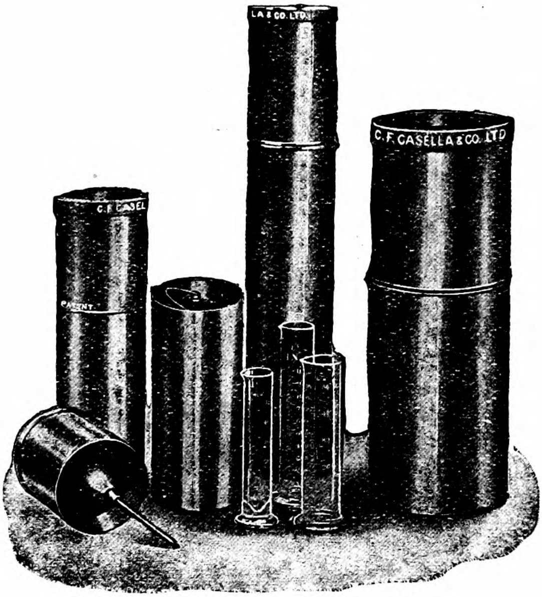

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Weather Prediction by Numerical Process: A Review of Mr. Richardson's Work.

BY F. J. W. WHIPPLE, M.A.

Weather Prediction by Numerical Process, the remarkable book which has been written by Mr. L. F. Richardson, formerly Superintendent of Eskdalemuir Observatory, now lecturer at the Westminster Training College and one of the Honorary Secretaries of the Royal Meteorological Society, is devoted to the question whether the forecasting of weather by arithmetical methods of a particular type is possible. The astronomer can forecast the position of the moon years ahead with the greatest precision, why should not the meteorologist predict the weather with like accuracy? It is true that the meteorologist has to take into consideration many more factors, for if you begin to think how the weather of to-morrow is determined by the weather of to-day, you will realise that the mere specification of the weather of to-day is a complicated business. To-day's weather in the widest sense includes not only the distribution of pressure, wind, temperature, humidity and cloud amount all over the globe and at all heights, but also the intensity of radiation from the sun, the temperature of the sea, the state of the ground, the extent of ice and snow, and the rate of evaporation of moisture from trees and other vegetation.

Mr. Richardson is not dismayed by the length of this list. He deals with each factor in turn and shows how the contribution

---

Weather Prediction by Numerical Process. *By* Lewis F. Richardson, B.A., F.R.Met.Soc., F.Inst.P., 4to, $11\frac{1}{4} \times 8\frac{1}{2}$, xi + 231 pp., *diagrams.* Cambridge: University Press, 1922. 30*s.* net.

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of each factor to the changes in progress may be assessed with more or less accuracy and how the corresponding differential equations may be built up.

Before he went to Eskdalemuir and turned his attention to meteorology, Mr. Richardson had devoted much attention to the solution of problems in applied mathematics by numerical processes. The mathematician when confronted with a physical problem usually simplifies the conditions so as to make it amenable to his analytical machinery. The sledge-hammer method developed by Mr. Richardson requires no such preliminary paring down of awkward corners: it demands, however, conscientious attention to detail and no shirking of laborious arithmetic.

The scheme contemplates the tabulation and computation of the meteorological elements at some 2,000 stations distributed regularly over the globe. The stations are to be at the centre of " squares " in a chessboard pattern. For the black " squares " certain elements such as pressure are computed, for the white " squares " others such as the strength and direction of the wind at various heights. Each computation starts with the weather of one instant and determines that three hours later. Judging by his own experience, Mr. Richardson allots thirty-two computers to each pair of stations. He does not seem to have allowed sufficiently for the increased speed of routine computation as compared with pioneer work, but on the other hand his computers are working day and night. We must multiply the number by three to provide for shifts. Moreover, he does not allow for the revision of the forecast as later information comes to hand. There should be an advance guard forecasting, say, six months ahead, another division forecasting three months ahead and others, perhaps, one month and one week ahead. Taking these requirements into consideration we cannot keep the number below 50,000. Moreover, even if the scheme were perfected, the really interesting weather would not be forecasted, for thunderstorms and tornadoes as well as the secondary features of the cyclones of the temperate zone would be " smoothed out " in the highly generalized specification of the meteorological situation.

In view of this criticism, which, it is fair to say, is put forward by Mr. Richardson himself, it hardly matters that the one forecast six hours ahead at one place, which he has computed, is sadly in error.

The trouble which he meets is that quite small discrepancies in the estimate of the strengths of the winds may lead to comparatively large errors in the computed changes of pressure. It is very doubtful whether sufficiently accurate results will ever be arrived at by the straightforward application of the principle of the conservation of matter. In nature any excess of air in one place originates waves which are propagated with the velocity of sound, and therefore much faster than ordinary meteorological phenomena.

One of the difficulties in the mathematical analysis of pressure changes on the earth is that the great rapidity of these adjustments by the elasticity of the air has to be allowed for. The difficulty does not crop up explicitly in Mr. Richardson's work, but it may contribute to the failure of his method when he comes to close quarters with a numerical problem.

The value of the book is not, however, to be judged by this failure. Its merit is that it insists on the study of all the various ways in which the meteorological elements act and re-act on each other. This ço-ordination of knowledge has been the stimulus to many special researches valuable in themselves but appearing now, for the first time, in their proper relations.

Meteorology is largely occupied with the consideration of eddies and whirls. Mr. Richardson parodies an old quip with the jingle,

> " Big whirls have little whirls, which feed on their velocity;
> And little whirls have lesser whirls, and so on to viscosity,"

and in his analysis of the dynamical conditions he brings out how the apparent viscosity of the air differs according to the scale of the phenomena. He considers that the interlacing of air currents on a large scale, as shown, for example, by the variation in the tracks of balloons in a Gordon Bennett race, indicate that the great currents across wide stretches of land must re-act on each other as if they had a viscosity far greater than that of treacle.

Whether our methods of forecasting are gradually developed from the present practice, or whether an entirely new system, such as the author's, is invented, he has done good service by helping meteorologists to obtain a clearer insight into the operation of the forces with which they deal.

The comprehensive scheme of this book should make it a useful work of reference. In this connection the list of symbols in Chapter 12 must be mentioned. Having exhausted the characters of our own language and of Greek, the author introduces novel symbols, some borrowed from Coptic, some with no names at all. For each symbol the interpretation is given in the international language Ido as well as in English. The publication of this list will facilitate the adoption of a standard notation for meteorological calculations. The actual demonstration of how a notation can be used consistently throughout a book covering such a wide field is preferable to much discussion by committees.

There is nothing new to say about the excellence of the work of the Cambridge University Press, the reviewer can only commend it to the notice of all readers of this book.

Official Publications.

Weather Forecasting in the Eastern North Atlantic and Home Waters for Seamen. By Commander L. A. Brooke Smith, R.D., R.N.R. 9½ × 6, 24 pp., illus., 1921. Price 6d.

The object of this pamphlet is to instruct seamen in the methods by which the reports received by wireless telegraphy from the transmitting station at Poldhu and from other ships may be utilised. Examples showing how a map may be constructed and used for forecasting are set out in detail. Such maps will soon be regarded as essential for safe navigation. They should be of interest to the passengers on Atlantic liners as well as to the navigating officers.

It may be added that the pamphlet will be of service to amateurs ashore who wish to utilise the wireless reports.

Advisory Committee on Atmospheric Pollution. Report on Observations in the Year ending March 31st, 1921. 4to., 32 pp. Plates and Diagrams. 1922. 2*s.* net.

The seventh report of the Committee for the investigation of atmospheric pollution contains interesting accounts of experimental work as well as the usual summaries of observations.

Dr. J. R. Ashworth has contributed a paper on a twin atmospheric pollution gauge designed to compare the amount of impurity carried into a town with the amount carried out; while Dr. J. S. Owens has investigated dirt in expired air, the effect of suspended impurity on health, and the relation of visibility to suspended impurity.

Discussions at the Meteorological Office.

March 20th, 1922. *The Mean Condition of the Atmosphere during the South-Föhn.* By Luise Lammert. (Leipzig: Geophs. Inst. der Univ. Veroff., 1920, Bd. 2, Heft. 7.) Opener—Mr. R. Corless.

Most previous investigations of the south-Föhn, the warm and unusually gusty southerly wind which is experienced chiefly in winter on the northern side of the Alpine mass, have been concerned with the consideration of surface conditions. The authoress of the present paper has made a definite attempt to throw light on upper air conditions during the Föhn. To this end she grouped together the pressures and temperatures for certain days in the period 1906–12 for which the international soundings of the upper air were available and which were also days of Föhn, whilst information concerning air motion was derived from certain days in 1913–14, during which period numerous pilot balloon ascents were made by the Italian Aerological Service. It will be noticed that this selection of different data from different periods and the investigation of mean conditions is justified only if the general conditions during the Föhn are always the same or nearly so. From the data thus selected charts were constructed showing the distributions of temperature, pressure and stream-lines at various levels over an area comprising northern Italy, France and Germany.

It is found that the distribution of temperature at the surface, viz., an area of warm air extending from the northern side of the Alps into Germany and a cold area south of the Alps, becomes reversed as the stratosphere is approached. The mean surface pressure distribution shows a large depression to the north-west of Europe and, south of the Alps, an intrusion of high pressure from the east. With increase of height the distribution becomes more regular and at about 10 km. the gradient is for north-westerly winds over practically the whole of the area considered. There appears to be little difference in mean temperatures at all heights between the windward and leeward sides. The mean temperature in the first kilometre or so at Munich is few degrees higher than that at Pavia, but this relationship is reversed at the level of the stratosphere. There is evidence that the Föhn effect is most marked at 600–900 metres above the surface and that the Föhn often fails to break through to the surface. Immediately to the windward of the main axis of the Alps the surface air movement appears to be from the north, but at a height of 2 km. the air either travels round the mountains or crosses them by way of the passes. A vortex with a horizontal axis is definitely located near to the windward side and it is found that upward motion of the air is still well marked at 5 km. just to the windward of the mountain axis.

The average temperature lapse rate is less than adiabatic and the average upward velocity of the air to the windward is about 0·1 metres per second.

From the state of affairs revealed by this investigation it seems that the process in operation during the Föhn may be likened to that of driving a steam engine backwards, the requisite energy supply being derived from that associated with the depression to the north-west of Europe.

In the subsequent discussion it was the general opinion that the authoress was not justified in dealing exclusively with the mean conditions, and it was pointed out that no mention was made of condensation or precipitation on the windward slope of the mountains. Sir Napier Shaw stated that soon after the onset of the southerly current a certain amount of air is forced over the mountains, but that there is soon no further tendency for this to occur and that the prolonged Föhn effect can only be explained by the existence of very effective eddy-motion and that the most developed eddy should be on the leeward side. Dr. Simpson favoured the basic conception that by reason of the presence of the depression to the north-west of Europe surface air is drawn away from the leeward side and that air must necessarily descend to take its place. Other points raised were the apparent infrequency of occurrence of Föhn winds and the fact that the descending air is not necessarily that which has somewhat earlier ascended the windward side of the mountains.

The Royal Meteorological Society.

THE March meeting of the Royal Meteorological Society was held on Wednesday, March 15th, at 49, Cromwell Road, South Kensington; Dr. C. Chree, F.R.S., President, in the chair.

Before the ordinary business of the meeting, the President announced that the Council had accepted a proposal put forward by the Trustees of the British Rainfall Organization for the transfer to the Society of the lease of the old headquarters of the Organization at 62, Camden Square, together with the balance of the Endowment Fund. The conditions attached to the gift were that the Society should, as far as possible, undertake the maintenance of the meteorological observations at Camden Square and should devote the funds to the encouragement of rainfall work.

Dr. H. R. Mill, in formally handing over the property to the Society, gave a brief account of the circumstances. He spoke of the ideals which he, as successor of the late Mr. G. J. Symons, had cherished with regard to the rainfall work. The plans which were made in 1910, when the Organization was handed over to a body of Trustees, were not entirely realized owing to the breakdown of his own health and to the outbreak of war. Through the war years the work was kept going, although with great difficulty; but the stringency of 1918 made it plain that either the income must be trebled or the work allowed to pass out of private hands. When in the following year the Organization was taken over by the Meteorological Office, the Trustees retained the Endowment Fund and the house in Camden Square, the latter being leased to the Office of Works. It had now been decided to remove the Headquarters to South Kensington.

The Trustees regarded the time as opportune for handing over the house to the Society, asking them to accept the responsibility for the maintenance of the meteorological observations, one of the most accurate and homogeneous series kept in this country. With regard to the possibility of securing the freehold of the house, and with regard to the employment of the endowment fund, the Trustees wished to leave the Society a large freedom of action. The fund was created in order to encourage the measurement of rainfall by voluntary workers, looking to the geographical rather than purely physical aspects. He earnestly hoped that the motive animating the Society in this matter would be the kindling and fostering of a spirit of enthusiasm in observation and research.

The meeting, as is customary in March, was devoted to a lecture, the lecturer this year being Dr. E. M. Wedderburn. A brief abstract follows :—

Dr. E. M. Wedderburn, O.B.E., F.R.S.E.—Seiches ; and the effect of Wind and Atmospheric Pressure on Inland Lakes.

The name " Seiche " given to quasi-tidal movements of the level of inland lakes, originated in Switzerland. The scientific study of these movements began about the year 1730 on Lake Geneva, but their character as standing oscillations of the water in the lake was not recognised until Forel began his classical series of observations on that lake in 1869. At a much earlier date it had been realised that there was an intimate connection between these movements and atmospheric pressure, though some observers suggested as causes the emission of gases, or the existence of large abysmal monsters. In 1905 the late Professor Chrystal made a careful study of the seiches in Loch Earn for the Scottish Lake Survey. Simultaneous observations with a Dines-Shaw micro-barograph enabled him to discuss the effect of small barometric disturbances with much greater exactitude than had previously been possible, and he was able to show that microbaric disturbances were the most frequent cause of seiches. Other possible causes appear to be heavy rainfall over part of the lake, rapid flooding, and wind squalls. Earth tremors appear to have caused considerable movements on a few exceptional occasions. The Scottish Lake Survey also discovered the existence of internal seiches of large amplitude. During autumn, in all lakes of considerable depth, there is at the surface a layer in which there is little variation of temperature with depth. At the base of this layer there is a shallow layer, called the discontinuity layer, in which the fall of temperature is rapid, while below this is the bottom water of the lake, in which temperature variations are small.

The effect of wind blowing along a lake is to accumulate the warm surface-water at the lee end, so that the discontinuity layer is displaced from its normal horizontal position. When the wind ceases or moderates, a standing oscillation commences at the discontinuity layer, which separates the top and bottom layers. The period of oscillation depends on the difference of density between these layers. The oscillation may be of large amplitude, many feet, without measurable disturbance of the level of the free surface.

Correspondence.

To the *Editors, "Meteorological Magazine."*

Exceptional Visibility at Malta.

I WISH to bring to your notice a curious case of visibility noticed to-day at this Station.

At 8 o'clock (local time), the sky was overcast and covered by a layer of cumulo-stratus which kept out the rays of the sun. Towards the northern horizon, the hills of Sicily could be clearly seen by the unaided eye, although the distance is about 60 miles. When I used my 2½-inch telescope, I could clearly distinguish the trees and most of the buildings. Evidently the sky was clear over Sicily, as I could notice the eastern sides of the buildings illuminated and relatively sharp against the darker background. The phenomenon decreased in proportion as the sun came out locally, and the glare stopped the whole thing at 9 o'clock.

On November 18th, 1904, I had occasion to notice the same phenomenon, and I can give a sketch of a distant church and steeple which I noticed on that occasion, and which I believe that I have been able to identify to-day.

D. THOS. AGIUS.

R.A.F. Meteorological Station, Malta, March 15th, 1922.

[This account recalls the curious appearance observed at Malta on March 29th, 1784. At one o'clock on that day, great excitement prevailed in the streets, for a new island had apparently sprung up, and sailors and fishermen hurried out to take possession of it. It turned out, however, to be the top of Mount Etna, and later the hills and buildings of Sicily became visible.

This example, first described by Dangos in *Observations sur les refractions terrestres : Mém. Savan: Étrang.*, 1806, I., pp. 463–468, is quoted in Pernter and Exner's *Meteorologische Optik,* p. 77. The appearance of the mountain top as an island indicates that no rays from such lower parts of the land as were normally in sight could reach the observer's eyes, and that the horizon was brought much closer than usual.—ED. M.M.]

Detonating Fireballs observed in Sunshine.

A BRILLIANT fireball was observed from Bristol, Cardiff, and other places on February 7th at 3.55 p.m. The sounds resulting from its disruption were very loud, and were reported from many stations in Warwickshire, Herefordshire, Worcestershire, Oxfordshire, Gloucestershire, and even Somersetshire. They occasioned startling vibrations, and people did not know whether to attribute them to thunder or to a great explosion.

In some cases there is no doubt that meteoric detonations of this character have been erroneously attributed to thunder peals, earthquake shocks, or distant explosions.

The fireball of February 7th passed from nearly over Oxford to Shropshire, its height declining along a flight of about 80 miles from 56 to 32 miles, which it traversed at a velocity of 10 miles per second. Its radiant point was in the constellation Eridanus, near the bright star Gamma. The object was at its brightest when about half of its path had been completed, for over the district about 25 miles south of Birmingham; jets of fire and sparks were thrown off from the nucleus and the detonations were of great violence. As a sample of the descriptions which have come to hand, the following by Mr. A. W. Keep, of Quinton (see *Birmingham Daily Post*, February 13th), may be quoted :—

> "On Tuesday afternoon, about 4 p.m., a loud explosion, which is described by my wife as having literally shaken the ground, startled a number of people at Quinton, causing cattle and horses to gallop about the fields and frightening my dog so much that he ran for his life! No local cause for the noise was forthcoming."

I saw the fireball myself at Bristol, and heard a deep sound as of a distant thunder-clap about 4½ minutes later.

These large daylight meteors are not so rare as might be imagined—twelve have been witnessed in the British Isles since the beginning of 1902. They deserve special investigation in view of the fact that they are often attributed to other causes, and especially so when clouds veil their luminous flights, and the only manifestations are the loud sounds and earth tremors which they produce.

Certain epochs of the year appear to be unusually prolific in detonating fireballs, as, for example, that of November 19th–23rd.

W. F. DENNING.

Bristol, February 21st, 1922.

Definition of Frost in the Open.

ON January 4th last, when there was a strong, dry, north-west wind, nearly an inch of ice was formed here with a minimum temperature in the screen as high as 31° F. This is a case where low humidity and movement of the air played a greater part in the formation of ice than low temperature. In order to define the strength of a frost, it would appear to be necessary to take into account all three factors as well as the effects of radiation but, unfortunately, the readings of the wet-bulb thermometer are not very reliable when the temperature of the air is below freezing point. However, it is a simple matter to record the temperature on the grass and I submit that when " degrees of frost " are spoken of, the reference should be to the indications of the thermometer exposed to the full effects of radiation. The term " ground-frost " would not appear to be necessary, since if it is freezing on the grass, frost is apparent everywhere in the open, and ice may be formed on water several feet above the ground. Thus at 7 h. on February 19th last there was a thin sheet of ice on the rainwater tank in my garden. The tank is 7 feet above the ground and the indications of the minimum thermometers 60 feet away were 33°.1 F. in screen and 29°.5 F. on grass.

I have noticed, when skating, that the ice keeps dry and in good condition so long as the thermometer on the ground is down to 32° F., even if the sun be quite strong and the temperature of the air be as high as 40°. If, however, it becomes cloudy and the temperature of the air falls to, say, 35° F., whilst the thermometer on the ground rises to the same level, a thaw at once sets in.

The views of other observers on this matter would be interesting and helpful to me.

DAVID HILL OWEN.

192, Redding Lane, Sparkhill, Birmingham, 8th March 1922.

[The point which Mr. Owen emphasizes, that the reading of the " grass minimum thermometer " is essentially the temperature of a radiating body is in accordance with *The Observer's Handbook.* In recent editions of the Handbook the following paragraphs have appeared :—

> " *Terrestrial Radiation Thermometer.*—A grass-minimum thermometer does not record the temperature of the air, but rather its own temperature, *i.e.*, that of a bulb filled with spirit, losing heat by radiation in all directions, and receiving heat by radiation from the clouds and from the atmosphere itself, from the ground, and from surrounding objects, and by contact with the air."

> "Although the grass-minimum thermometer does not give the temperature of the air or of the grass-blades, its readings do indicate the circumstances in which those temperatures are high or low. It is customary in this country to count as ground-frosts the occasions on which the temperature recorded by the grass-minimum thermometer is 30° F. or lower."

Observations with thermometers exposed at various heights are necessary to settle the question how far Mr. Owen's suggestion to drop the term "ground-frost" is acceptable.—Ed. M M.]

A Curious Ice Formation.

On the morning of Sunday, February 5th, I noticed an unusual formation of ice on the ground in the form of "ice pinnacles" or upward pointing icicles They were to be found only on bare ground and invariably had small pieces of chalk or in some cases small pieces of broken brick or ashes as a base; in no instance on flints or on the soil itself. They were generally about two inches in height, mostly quite straight, but sometimes curved. Externally they had an appearance of striation; they were hollow, partly filled with feathery snow-like crystals.

In low-lying fields they were extremely numerous and were observed over a large district including Welwyn, Hitchin and Luton. The air was very cold the preceding evening, with a light snow which melted as it reached the ground which overnight showed no signs of ground frost, but was frozen on the morning of the 5th. During the night the velocity of the wind was from 3 to 12 miles per hour, minimum grass temperature 26° F., minimum screen temperature 27° F. On the 4th at 9h. the temperature one foot below the surface was 42° F. and on the 5th, 38° F. No hoar frost was recorded.

Alfred Latchmore.

Hitchin, February 13th, 1922.

[The formation of "ice pinnacles" as described by Mr. Latchmore is a fairly common phenomenon in chalky districts, being caused by the exudation of moisture from porous soil. We do not know whether the details of the process have been investigated. Cleveland Abbe has invoked surface tension to explain* a somewhat similar phenomenon, the growth of the ice pinnacles which push up soil or gravel, but we have not found it possible to adapt his explanation to the present case.—Ed. M.M.]

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* *Monthly Weather Review, Washington,* April 1905, p. 157. See also, *ibid.*, December 1905, p. 527, and July 1916, p. 386.

The Drought of 1922.

It may help to impress the seriousness of last year's drought on our minds to mention that from October 1st, 1920, to December 31st, 1921 (15 months), the rainfall of every month was below its average at this station. In previous years from and including 1900, when my record begins, there were never less than three months above the average in the year.

Alfred Walker.

Ulcombe Place, Nr. Maidstone, 13th March, 1922.

Weather Lore.

Sir Napier Shaw mentions the local belief in the windiness of Edinburgh, and asks why it should be so. In *Tristram Shandy,* Sterne mentions a similar belief about Avignon and asks the same question. The passage contains some shrewd remarks about the folly of drawing general conclusions from isolated instances and is worth quoting :—

> " Before I go further, let me get rid of my remark upon Avignon, which is this : That I think it wrong, merely because a man's hat has been blown off his head by chance the first night he comes to Avignon, that he should therefore say, 'Avignon is more subject to high winds than any town in all France' : for which reason I laid no stress upon the accident till I had enquired of the master of the inn about it, who telling me seriously it was so—and hearing, moreover, the windiness of Avignon spoke of in the country about as a proverb—I set it down, merely to ask the learned what can be the cause."—(" Everyman's " edition, p. 390.)

E. G. Bilham.

The Oaks, Cambridge Road, Twickenham, March 23rd, 1922.

Meteorological Terms.

The Meteorological Office is, I see, raising the question of the meaning of " fine to fair " to the man in the street. May I deprecate the use of the word " local." The man in the street thinks of his local paper, and, if a " local shower " does not fall in the spot where he happens to be, he curses the Meteorological Office. I suggest " in places " instead of " local."

H. Nowell ffarington.

Worden, Leyland, Lancs, Feb. 3rd, 1922.

NOTES AND QUERIES.

Coal Smoke Abatement.

A DEPUTATION, organized by the Coal Smoke Abatement Society, was received at the Ministry of Health on March 20th, 1922, by Sir Alfred Mond. The object of the deputation was to urge the Government to give legislative effect to the recommendations made by the Departmental Committee under the chairmanship of Lord Newton. Representatives from various boroughs as well as from learned, scientific and health institutions were present. Sir Napier Shaw and Mr. F. J. W. Whipple represented the Royal Meteorological Society.

Sir Aston Webb, in his speech, laid stress on the great damage by smoke to works of art and to property, as well as to health and pointed out the great waste of fuel, amounting to a loss of many millions in a year.

The Lord Provost of Glasgow described the work done in that city, and Mr. Smith, in the unavoidable absence of Mr. Clynes, discussed the problem from the point of view of the working-classes.

Sir Napier Shaw referred to the work of the Committee on Atmospheric Pollution and pointed out that two-thirds of the smoke was from domestic fires and suggested that a special abatement in rates should be conceded to houses producing no smoke.

Sir Alfred Mond said that before the report was adopted he should have to discuss it in detail with Lord Newton. He mentioned that the recommendation in the Report that the Ministry should appoint competent advisers to help local authorities and manufacturers had already been carried out.

The Economic Value of Dry Air.

A PAPER by J. Bronn on means of providing dry air cheaply, which was published in *Stahl und Eisen* for June 16th, 1921, has directed the attention of ironmasters in this country to the economy of utilising dry air instead of moist air for feeding blast furnaces. Experiments conducted at the great ironworks at Rombach showed that the air near ground level generally contained 20 per cent more moisture than that at a height of 100 ft. When the works are in full swing great clouds are given off from the water sprayed on the hot iron for cooling it, and if no precautions are taken this water vapour is pumped into the furnaces with the air. Not only is it wasteful to spend the energy of the pumps on this unnecessary work, but the complete combustion of the coke in the furnaces is delayed, heat being generated in the chimney instead of under the melting ore.

It has been found profitable at Rombach to connect the suction for all the blowing engines to a tower 150 ft. high and so obtain a supply of dry air. It is reckoned that the saving in coke by this change of practice may amount to 3 per cent. On the other hand, there are no heavy running expenses such as are incurred with the more thorough-going Gayley process, in which the air is deprived of all it moisture by passage through a chamber where it is cooled to the freezing point.

There must be many other industries which might profit by the experience of the ironworks. The atmosphere surrounding electric power-stations is frequently filled with steam from the cooling towers, and some of this steam must find its way to the furnaces of neighbouring works. Laundries again must suffer by the introduction of moist air into the drying rooms and for them also the installation of towers from which dry air could be drawn would probably prove economical.

International Investigation of the Upper Air.

As announced on page 20 of the *Meteorological Magazine* for February, 1922, January 17th, 18th and 19th were set apart as international days for the investigation of the upper air. It happened that on these days the last phase, or the " death," of a cyclone was taking place

Some account of the observations made in the British Isles may be of interest. Observations were made as nearly as possible at 7h. and 18 h. at twenty-three stations. Nephoscope observations were obtained from fifteen stations, cirrus being reported from thirteen. Upper winds were observed from eighteen stations by means of pilot balloons. In the majority of cases a single theodolite was used, but at Larkhill and Shoeburyness two theodolites were utilised on some occasions. At Shoeburyness, also, the wind at 18,000 feet was obtained by means of a shell-burst. The greatest height reached by a pilot balloon was 20,000 feet, ascents of this height being recorded both from Felixstowe and from Valencia. The majority of balloons did not reach great heights owing to the presence of low cloud. Seven stations recorded upper air temperatures, the results being obtained by aeroplane ascents at Andover, South Farnborough, Baldonnell; and the Isle of Grain, by registering balloons at Benson, by kite-ballon and meteorograph at Shoeburyness, and by kite and meteorograph at Pulham. The upper winds were moderate to strong and had a marked westerly component. The lowest temperature recorded in the aeroplane observations was 235a (– 36° F.) at 18,000 feet at South Farnborough.

The Conquest of the Air.

A NEW record for flight duration has been officially recognised by the Fédération Aéronautique Internationale, which publishes world records from time to time in its Bulletin. This record flight was made in America on December 29th and 30th, 1921, by F. Stinson and L. Bertand, the duration being 26h. 19m. 35s. The previous record, which was a French one, was 24h. 19m. 7s.

A speed equivalent to 206 miles per hour was obtained over a distance of 1 kilometre by Sadi Lecointe at Villesauvage on September 16th, 1921, and speeds of over 170 miles per hour have been recorded for flights over longer distances.

Major R. W. Schroeder's ascent* of 36,000 feet at Dayton, Ohio, on February 27th, 1921, is still the record for altitude, but a report† which will, it is hoped, be authenticated later, has been received of a still higher ascent—of over 40,000 ft.—also at Dayton.

News is also received of a daring flight by Major Cotton, a British airman, carried out under very unfavourable conditions. Major Cotton set out from St. John's, Newfoundland, with mail for the lonely settlement at Cartwright, Battle Harbour, on the Labrador coast. Flying was rendered very difficult by great masses of cloud, but St. Anthony, 200 miles away, was reached in 2½ hours. After leaving St. Anthony, Major Cotton encountered a severe snowstorm, but he reached Battle Harbour and, despite a strong east wind, landed safely. One of his skids was damaged, however, but after this had been repaired, Cartwright, 100 miles away, was reached. Major Cotton landed in the midst of a group of rather scared Eskimos who had never before seen an aeroplane. The settlers at Cartwright were surprised to receive letters from Newfoundland which had been written only the day before, for from January to June the coast is closed and they are cut off from the world. The return journey to St. John's was accomplished in five hours.

This flight is not only a fine feat of endurance, but also a record, for flight under such conditions has hitherto been considered impossible.

Wireless for Tristan da Cunha.

It is reported in the Press that the Rev. H. M. Rogers, who sailed last month for the lonely island of Tristan da Cunha to take up the chaplaincy, has taken with him "wireless" apparatus with a range of over 1,000 miles. The apparatus was presented to Mr. Rogers by the people of Cape Town to whom the loneliness of the island has always appealed.

Mr. Rogers is also taking with him meteorological equipment furnished by the Government so that he may send reports of the weather conditions by wireless telegraphy to South Africa and to passing ships. The message should be of considerable assistance to forecasting in South Africa.

Some account of meteorological work at Tristan da Cunha is given in this Magazine for April, 1920, p. 49.

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* *Meteorological Magazine*, March 1920, p. 25.

† *Ibid.*, October 1921, p. 269.

A Test of "Simple Weather Forecasting."

READERS of *Simple Weather Forecasting,** the pamphlet in which Messrs. Horner and Robertson have set out the principles on which their published forecasts are prepared, find it difficult to select clear-cut statements which can be submitted to the test of experience. There is one rule, however, on the face of it definite enough to claim rank as a proverb "When the cold snap in the spring occurs early, the summer will be early."

It has been thought worth while to examine the weather records for south-east England for 21 years with this dictum in mind.

As to what periods the expression "a cold snap in the early spring" and an "early summer" may refer, no two people may agree, but for the purpose of this enquiry a cold snap in the spring was said to occur early when it occurred in February or March, and the summer was regarded as early when summer conditions prevailed during May or June.

Of the 21 years from 1901 to 1921 there were nine in which the "cold snap" occurred in spring. In four of these years, 1901, 1905, 1917 and 1919, the "early summer" followed, but in the others, 1904, 1906, 1908, 1909 and 1916 it did not.

The available evidence, therefore, shows that any relation which may exist between the weather of spring and summer is not to be summed up in such a formula as is proposed in *Simple Weather Forecasting.*

La Société Belge d'Astronomie, de Météorologie et de Physique du Globe.

THE Belgian Society for Astronomy, Meteorology and Terrestrial Physics celebrated the completion of its twenty-fifth year by a "séance solennelle" on December 15th, 1921, at which the King and Queen of the Belgians and representatives of many of the European Governments were present.

The January number of *Ciel et Terre* is devoted to an account of the proceedings, which included a lecture by Monsieur B. Baillaud on astronomy and one by General Ferrié on wireless telegraphy and telephony.

The Society is to be congratulated on its recovery after the great strain produced by the war, and its distinguished President, Monsieur F. Jacobs, on his long term of office, coincident with the life of the Society, which, in fact, owes its existence to his initiative.

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* *Simple Weather Forecasting for Everyone,* by D. W. Horner and W. M. Robertson. Tunbridge Wells, 1921.

Radiation at Benson.

RADIATION MEASURED AT BENSON, OXON, 1922.

Unit : one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays).

Averages for Readings about time of Sunset.

		Jan.	Feb.	Mar.
Cloudless days :—				
Number of readings	n	11	14	19
Radiation from sky in zenith	I	409	420	456
Total radiation from sky	J	442	458	488
Total radiation from horizontal black surface on earth.	X	618	640	667
Net radiation from earth	X–J	176	182	179

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

		Jan.	Feb.	Mar.
Cloudless days :—				
Number of readings	n_0	3	5	3
Radiation from sky in zenith	I_0	21	25	26
Total radiation from sky	J_0	25	33	39
Cloudy days :—				
Number of readings	n_1	9	5	5
Radiation from sky in zenith	I_1	38	55	75
Total radiation from sky	J_1	34	53	64

Radiation from the Sky at Benson.

IN the January number of the Magazine there is an editorial comment* on the difference of the averages of the net radiation from the ground for 1920 and 1921. The following is the explanation :—

For 1920 no direct observations on the radiation given out by the ground were available and to supply the deficiency it was assumed that the radiation from the ground was that of a full radiator at a temperature of 50° F., which is close to the mean annual temperature at Benson at a depth of 1 foot. For 1921 the observations of radiation from the ground (a grass field) are available and have been used as a standard. It appears that the observed radiation from the gound is, for 1921 at least, some 20 g.c. less than that from a full radiator at the temperature in the screen at the time and thus two-thirds of the discrepancy is accounted for.

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* p. 351.

The remaining 10 g.c. difference may well be a casual deviation especially when the exceptional heat and dryness of the year 1921 is remembered.

The radiation from the ground seems to be a very variable quantity and subject to a large diurnal oscillation the amplitude and phase angle of which have not yet been determined.

W. H. DINES.

Cosmic Dust?

DR. OWENS and Mr. Watson have recently. detected in the atmosphere of London particles comprised of a clear, glassy material, and perfectly spherical in shape, of diameter from 1·5 microns downwards. Such particles had been observed occasionally at earlier dates, but they did not appear in large numbers until March 16th; a maximum was reached about March 26th, when there were about 500 such particles to the cubic centimetre. The subsequent decrease has been gradual.

It has been suggested that the particles may be derived from volcanic eruptions, both Etna and Vesuvius having been active recently, or that they may be cosmic dust.

Meteorological Stations.

AS announced on p. 66, the meteorological station at 62, Camden Square, N.W.1, originated in 1858 by the late Mr. G. J. Symons, F.R.S., and maintained since 1919 as an official station of the Meteorological Office, has now been taken over by the Royal Meteorological Society. It is hoped that the continuation of the records, for at least the 20 years remaining of the lease of the house, has been secured, and that arrangements for permanence may be possible. The old "Glaisher" thermometer screen has been replaced by a Stevenson Screen and the observations have been slightly simplified. For the present, the observations are being undertaken by the North London Collegiate School.

Summer Time Act.

SUMMER Time came into force this year on March 26th and will continue until October 8th. Observers are reminded that it is important to state explicitly the standard of time on all communications with regard to natural phenomena observed during the summer months.

Rain-Making in Central Africa.

According to the Rev. John Roscoe, who has just published *The Soul of Central Africa,* rain-making can be a very uncomfortable profession. Mr. Roscoe describes the work of the rain-makers in Ankole, a remote province in the heart of Africa. When rain is needed, the rain-makers are sent for and told to produce it. Should they fail, they are made to sit in the sun and are fed on liver cooked in butter with as much salt as can be got into it. When the unfortunate men beg for water, they are told to " Bring rain and quench your thirst." On the other hand, if too much rain falls, and the rain-makers fail to stop it, they are forced to drink enormous pots of water until the rain ceases.

Meteorological Terms in the Malagasy Language.

The Malagasy names for some of the more striking weather phenomena are given in *A Naturalist in Madagascar,* by James Sibree.

Sun	Day's Eye	Mascandro.
Milky Way	Dividing of the year	Èfitaona.
Rainbow	God's great knife	àntsibèn Andriàmànitra.
Waterspout	Tail of the sky	Ràmbondànitra.
Cirrus Clouds	Sky gossamer	Faròran-dànitra.

These terms are certainly picturesque. That of the waterspout is really very apposite. As regards the Cirrus clouds, it is interesting to see how the same forms suggest different ideas to various nations. (Latin : a lock of hair or fringe; English : Mares' tails). The Malagasy name is certainly the most poetical.

Cicely M. Botley.

Weather Terms used by the Hastings Fishermen.

The following note by Mr. W. R. Butterfield is copied by permission of the author from the *Hastings and East Sussex Naturalist,* Vol. iii, 3 :—

> " The vocabulary of the Hastings fishermen includes some curious meteorological terms, and as these are rapidly being lost, it may be as well to give a list of them in this journal. When there is a dead calm, with the air hot and moist, the weather is said to be ' planety.' If it is oppressively sultry, with a heavy sky and oily sea, it is ' swallocky,' and presages a heavy storm which sometimes breaks suddenly with a roaring squall. A long loop of cirrus cloud with trailing ends is called by the curious name ' eddenbite '; blown-out streamers of white cloud are

'windogs,' as are also solar halos; large, ragged patches of nimbus cloud scurrying before a wind are 'messengers'; small, scattered, low cumulus clouds floating in an otherwise clear sky are 'pot-boys.' A mock-sun or parhelion is known by the name 'smither-diddles' and regarded as a sign of bad weather. The fishermen distinguish between hard and soft hail, the latter being described as 'egger-nogger.' Changeable weather is described as 'shucky' and when there is every prospect of really 'dirty' weather the conditions are described as 'truggy.'"

Retirement of Mr. R. S. Sargeant.

THE retirement of Mr. R. S. Sargeant took place on March 31st, after a period of service in the Meteorological Office which dates from 1871. Mr. Sargeant is the last of the senior members of the Office Staff who can claim that his first appointment was made in the days when the late Dr. R. S. Scott was in charge of the Office. Throughout the greater part of his career Mr. Sargeant has been associated with the Forecast Division, and since 1901 he has been one of the officers in charge of the issue of forecasts and gale warnings. The war brought with it a great increase, both in the scope and in the responsibility of such work, and Mr. Sargeant responded to the call with unfailing devotion. We wish him good health and prosperity in his retirement.

Fog and Frost Warnings at Cranwell.

AT the Royal Air Force Station at Cranwell a Frost Warning Signal has been in use during the winter months. On occasions when a frost, likely to cause damage to water-pipes, machinery and so on, has been forecasted, a red light is exhibited between 16h. 30m. and 18h. and again between 22h. and 22h. 30m. Fog warnings are also issued at Cranwell. Both fog and frost warnings are communicated from Cranwell to the Great Northern Railway Company's junction at Sleaford, as required.

The Horse Latitudes.

ACCORDING to more than one handbook of meteorology the "horse latitudes" are so called because on various occasions vessels, whose cargoes consisted of horses, were becalmed there and owing to the heat the horses died. Can any reader supply the original authority for this statement or, failing that, a more plausible explanation of the term?

The Weather of March 1922.

THE wind circulation over north-western Europe during the first week was generally cyclonic; depressions from the neighbourhood of Iceland passed eastwards across the north of Scandinavia, while secondary disturbances traversing the British Isles occasioned variable mild weather and rather frequent gales.

On the 1st, gales and strong winds were experienced in southern England. Kew at 2h. 30m. measured a gust of 24·5 metres per second, and later on the same day a line-squall, moving eastwards over the same area, caused a drop of temperature amounting at Kew to 6° F. Gales were again recorded on the 3rd and the 5th–6th. Temperature fluctuated a good deal, but was generally above normal, while on the 3rd a marked increase took place over Holland, the maximum reading at Groningen rising 15° F. The maxima at Benson, Gorleston and Pulham rose to 59° F., and on the following night, minima were very high, 52° F. being recorded at Kew. Rainfall was heavy at times; that at Penzance on the 1st measured 30 mm., and on the 5th 26 mm. were recorded at Eskdalemuir.

The breakdown of the westerly type followed on the arrival from the Atlantic of a disturbance of exceptional intensity. At 7h. on the morning of the 7th this depression was in mid-ocean and showed no extraordinary vigour. It deepened considerably, however, during its passage, and by the time it reached Plymouth, pressure at the centre had sunk to 970 mb. Wind velocities in Southern England, and especially in the western Channel, were abnormally high. Scilly recorded a gust of 108 miles per hour, a higher velocity* having been measured only once before in the British Isles. The history of its passage is well shown by the autographic records at Plymouth. The pressure, which stood at 1,000 mb. at 22h. on the 7th, fell quickly until 24h. and then extremely rapidly to 970 mb. at 5h. 15m. on the 8th, when the trough passed across. A very brisk rise followed, the barometer reaching 1,000 mb. again by 18h. The strongest winds occurred during the fall of pressure, the climax being reached at 4h. 10m. with a gust of 96 miles per hour, but thence onwards the velocity dropped even more quickly than it had risen. Temperature after some minor fluctuations rose from 46° F. at 1h. to 51° F. at 2h. 30m., a fall then commencing and continuing; the reading at 4h. 10m., when the screen was carried away,† being 44° F.

Rainfall reached it maximum intensity (3·8 mm. per hour) between 24h. and 1h.—then, decreasing steadily, 1 mm. was measured between 4h. and 5h. and none between 5h. and 6h. A further fall commenced after 6h., 1 mm. being measured up to 7h. Considerable structural damage was caused on the line of route. At Plymouth many ships dragged their anchors, trees of 5 ft. in diameter were uprooted, while a roof 30 ft. by 15 ft. was lifted and carried a distance of about 1,000 yards.

By 13h. on the 8th, the cyclone was centred off East Anglia, having moved eastwards, with a velocity averaging over 40 miles per hour.

In the rear of this extraordinary depression a northerly to north-easterly drift set in as an anticyclone advanced from the Atlantic, and by the 13th became established over our northern districts. It extended in a ridge eastwards and drier but colder weather became general except in the south-west. Meanwhile a depression in the region of the Bay of Biscay caused local precipitation (12 mm. at Paignton and 10 mm. at Plymouth being the largest), but only small falls occurred.

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* This gust, at Quilty, Co. Clare, January 27th 1920, which carried the pen beyond the edge of the chart, reached 110 miles per hour.

† See *Meteorological Magazine*, March 1922, p. 52.

Temperature fell considerably, severe frost being experienced during the night on several occasions. A minimum of 3° F. occurred at Särna on the 9th, and on the night of the 10th–11th 15° F. was recorded on the grass at South Farnborough, the screen reading at the same time falling to 21° F. Frost was experienced at Eskdalemuir on successive days, temperature falling to 21° F. on the grass and to 26° F. in the screen on the 18th. Milder conditions, however, had obtained in Scotland at times, and on the 12th Renfrew recorded a maximum of 57° F.; but on the whole during these days 50° F. was passed at but few places, while on the 18th the thermometer at Harrogate rose only to 39° F. During the same period southern Europe and the extreme north were influenced by depressions. On the 8th, Bayonne measured 81 mm. of rain; on the 15th 30 mm. fell at Sanguinaire, and on the 18th 21 mm. at Bronnö. Low temperatures were experienced at Spitzbergen, and 20° F. was recorded on the 17th,

By the 20th, weather conditions over the British Isles had become. much more unsettled, with cold northerly winds. Hail, snow and sleet, first experienced in Scotland on 20th, had by 21st travelled quickly south, falls of snow being recorded even in the Scilly Isles. The falls in the north were, however, much heavier than elsewhere, and with the wind half a gale at times, drifts many feet in depth were formed. An ascent on the 20th at Leuchars showed temperatures in the upper air to be much below normal, amounting to 15° F. at a pressure of 650 mb. On the night of the 20th–21st the whole country was gripped by frost; Benson then measured 14° F. of ground frost, and Plymouth 10° F. Severe frost was again experienced in the eastern and south-eastern district on the 24th. Screen minima fell to 20° F. at Grain and Shoeburyness, while at the latter station 20° F. of frost were recorded on the ground. On the following days maximum temperatures were also low; at Lympne and Tunbridge Wells 34° F. was the highest reading on the 22nd, and day temperatures in Northern Europe were generally below 40° F., the maximum at Bornholm on the 22nd being 28°.

A temporary change in type occurred on the 24th and 25th, when a depression moved in from the Atlantic across France, 60 mm. of rain being measured at Toulouse, but a return to northerly winds followed and frequent hail or sleet showers were recorded generally on the 29th. With the development of a depression off the south-west coasts, and a rise of pressure in the north, an easterly current became general. Maxima on the 31st fell to 40° F. or below except in the south-west, and severe frost was experienced over a wide area on the previous night. Sunshine was very variable in quantity during the month, but records of over 10 hours were obtained on the 12th, 21st, 22nd and 23rd.

S. F. WITCOMBE.

There was much general bad weather in Northern and Central France, with gales, during the early part of the month, and cold winds and snow in the latter period. The Mi-carême fêtes in Paris were quite spoilt. Temperature was also below normal on the Riviera; on the 26th the maximum reading was only 3° F. above that of London.

In the first week of the month during a heavy snowstorm in the Dauphiné Alps, in the department of Hautes Alpes, a number of living spiders, ants, caterpillars and other insects, unknown to the region, fell with the snow and were subsequently buried by another fall.

According to a report received from the Dobruja on the 17th, the Danube has overflowed its banks and several villages have been submerged.

It is stated in *The Times* on March 28th that unusually heavy rains have filled all but one of the historic reservoirs of Aden.

On the 31st another great cold storm, resembling that of February, paralysed the hydro-electric services throughout Western Ontario.

Fifteen persons were killed and many injured by a tornado in the State of Oklahoma, U.S., near the middle of the month. Strong floods were crumbling the banks on the Mississippi River in the neighbourhood of Helena, Arkansas, at the end of the month. A section of the Missouri-Pacific Railway was under water and the situation was becoming critical. There was a very extensive depression covering the whole of the Mississippi and Missouri Valleys on the 19th, with extensive rainfall, but later synoptic charts are not to hand.

During a severe thunderstorm on the 22nd a naval ammunition dump at Rio de Janeiro was struck by lightning and destroyed.

The special message from Brazil states that rain was irregular in the north but very excessive in the centre and south, being more than 100 mm. above normal in almost all parts, while many stations had an excess of 200 or even 300 mm. The heaviest falls came at the end of the month; there were destructive floods in the States of Rio de Janeiro and São Paulo. Thus while in the north-east the cotton crop is suffering from lack of rain, the rice crop in the south is being damaged by abnormally heavy precipitation.

At Rio de Janeiro pressure was 1·2 mb. below the normal for the month, and temperature was 1·1° F. above the normal.

On March 5th news was received of a disastrous cyclone which destroyed Chinde, the port at the mouth of the Zambesi, in Portuguese East Africa, on February 24th. It is stated to be the most disastrous event of its kind that has occurred on the East African Coast. The storm approached from the north-west down the river valley and lasted for 16 hours ending at midnight. There was a calm period of an hour about 17h. with a complete change of wind direction from westerly to easterly. The town, which was not very substantially built, was completely destroyed, and all the vessels, in the harbour save two, were thrown on shore, in several cases piled one on the top of another. The loss of life was, however, not very great. This cyclone appears to have been one from the south Indian Ocean which came unusually far west and recurved over the African Coast. During the

(*Continued on* p. 88.)

Rainfall Table for March 1922.

STATION.	COUNTY.	Aver. 1881—1915.	1922.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	1·83	1·51	38	83	·26	7	17
Tenterden (View Tower)	*Kent*	2·14	2·33	59	109	·73	7	19
Arundel (Patching Farm)	*Sussex*	2·15	1·95	49	91	·64	7	15
Fordingbridge (Oaklands)	*Hampshire*	2·33	2·53	64	109	·52	31	16
Oxford (Magdalen College)	*Oxfordshire*	1·53	1·70	43	111	·32	7	15
Wellingborough (Swanspool)	*Northampton*	1·79	1·62	41	91	·31	7	16
Hawkedon Rectory	*Suffolk*	1·90	2·21	56	116	·28	1	17
Norwich (Eaton)	*Norfolk*	1·91	2·25	57	118	·45	29	19
Launceston (Polapit Tamar)	*Devon*	2·98	4·42	112	148	·63	7	19
Sidmouth (Sidmount)	,,	2·44	3·12	79	128	1·28	31	17
Ross (County Observatory)	*Herefordshire*	2·03	2·91	74	143	·55	31	16
Church Stretton (Wolstaston)	*Shropshire*	2·36	3·17	81	134	·65	1	15
Boston (Black Sluice)	*Lincoln*	1·56	1·61	41	103	·29	7	20
Worksop (Hodsock Priory)	*Nottingham*	1·69	1·35	34	80	·24	7	21
Mickleover (Clyd House)	*Derbyshire*	1·78	1·96	50	110	·51	8	17
Southport (Hesketh Park)	*Lancashire*	2·23	1·34	34	60	·41	4	14
Harrogate (Harlow Moor Ob.)	*York, W. R.*	2·26	2·08	53	92	·29	5	19
Hull (Pearson Park)	,, *E. R.*	1·82	1·80	46	99	·35	1	22
Newcastle (Town Moor)	*North'land*	2·11	1·73	44	92	·30	25	19
Borrowdale (Seathwaite)	*Cumberland*	11·15	7·00	178	63	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	3·21	..	..	..	..	..	..
Haverfordwest (Gram. Sch.)	*Pembroke*	3·41	3·68	93	108	·75	7	17
Aberystwyth (Gogerddan)	*Cardigan*	3·47	3·39	86	98	·95	5	10
Llandudno	*Carnarvon*	2·17	1·81	46	83	·37	30	12
Dumfries (Cargen)	*Kirkcudbrt.*	3·61	3·15	80	87	·88	4	15
Marchmont House	*Berwick*	2·65	2·19	56	83	·29	20	21
Girvan (Pinmore)	*Ayr*	3·77	1·95	49	52	·42	4	14
Glasgow (Queen's Park)	*Renfrew*	2·61	1·67	42	64	·71	4	12
Islay (Eallabus)	*Argyll*	3·82	2·25	57	59	·47	4	16
Mull (Quinish)	,,	4·43	3·02	77	68	·82	4	16
Loch Dhu	*Perth*	6·59	3·40	86	52	1·10	4	11
Dundee (Eastern Necropolis)	*Forfar*	2·06	1·72	44	83	·43	6	15
Braemar (Bank)	*Aberdeen*	2·98	2·03	52	68	·26	4	19
Aberdeen (Cranford)	,,	2·58	2·47	63	96	·35	25,26	17
Gordon Castle	*Moray*	2·32	2·00	51	86	·39	26	18
Fort William (Atholl Bank)	*Inverness*	6·84	4·40	112	64	1·24	5	16
Alness (Ardross Castle)	*Ross*	3·26	2·89	73	89	·42	27	21
Loch Torridon (Bendamph)	,,	7·50	6·54	166	87	·93	7	20
Stornoway	,,	4·10	2·75	70	67	·46	4	22
Loch More (Achfary)	*Sutherland*	6·44	7·05	179	111	1·31	11	22
Wick	*Caithness*	2·27	1·67	43	74	·26	24	20
Glanmire (Lota Lodge)	*Cork*	3·10	2·33	59	75	·69	4	16
Killarney (District Asylum)	*Kerry*	4·71	4·54	115	96	1·40	4	16
Waterford (Brook Lodge)	*Waterford*	2·75	1·31	33	48	·35	4	15
Nenagh (Castle Lough)	*Tipperary*	3·09	2·07	53	67	·80	4	16
Ennistymon House	*Clare*	3·40	2·46	63	82	·64	4	15
Gorey (Courtown House)	*Wexford*	2·31	2·09	53	90	·30	4	17
Abbey Leix (Blandsfort)	*Queen's Co.*	2·62	1·49	38	57	·37	4	13
Dublin (FitzWilliam Square)	*Dublin*	1·94	1·05	27	54	·21	4	14
Mullingar (Belvedere)	*Westmeath*	2·70	1·97	50	73	·50	4	15
Crossmolina (Enniscoe)	*Mayo*	4·52	3·49	89	77	·41	4	18
Collooney (Markree Obsy.)	*Sligo*	3·46	2·93	74	95	·51	8	17
Seaforde	*Down*	2·92	1·94	49	66	·48	30	11
Ballymena (Harryville)	*Antrim*	3·15	2·27	58	72	·29	4	18
Omagh (Edenfel)	*Tyrone*	3·14	2·35	60	75	·30	8	16
Letterkenny Asylum	*Donegal*	3·80	2·25	57	59	·44	4	17

Supplementary Rainfall, March 1922.

Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate...........	..	..
„	Sevenoaks, Speldhurst	2·30	58
„	Hailsham Vicarage...	2·32	59
„	Totland Bay, Aston Ho.	2·86	73
„	Ashley, Old Manor Ho.	2·56	65
„	Grayshott...........	3·34	85
„	Ufton Nervet........	2·24	57
III.	Harrow Weald, Hill Ho.	1·69	43
„	Pitsford, Sedgebrook..	1·48	38
„	Chatteris, The Priory.	1·67	42
IV.	Elsenham, Gaunts End	2·40	61
„	Lexden, Hill House ..	1·55	39
„	Aylsham, Rippon Hall	1·98	50
„	Swaffham...........	2·04	52
V.	Devizes, Highclere ...	2·39	61
	Weymouth..........	2·44	62
„	Ashburton, Druid Ho.	6·25	159
„	Cullompton	2·96	75
„	Hartland Abbey	3·31	84
„	Penzance, Morrab Gden.	4·00	102
„	St. Austell, Trevarna.	3·67	93
„	Crewkerne Merefield Ho	3·66	93
VI.	Clifton College	3·59	91
„	Ledbury, Underdown.	2·63	67
„	Shifnal, Hatton Grange	2·63	67
„	Ashbourne, Mayfield.	2·39	61
„	Barnt Green, Upwood	2·08	53
„	Blockley, Upton Wold	2·37	60
VII.	Leicester, Town Hall Sq.	1·81	46
„	Grantham, Saltersford	1·82	46
„	Louth, Westgate	2·38	61
„	Mansfield, West Bank	2·00	51
VIII.	Nantwich, Dorfold Hall	1·87	47
„	Bolton, Queen's Park.	3·32	84
„	Lancaster, Strathspey.	2·38	61
IX.	Wath-upon-Dearne...	1·44	37
„	Bradford, Lister Park.	2·53	64
„	West Witton.........	3·04	77
„	Scarborough, Scalby..	3·31	84
„	Middlesbro', Albert Pk.	1·44	37
„	Mickleton...........	2·30	58
X.	Bellingham	2·45	62
„	Ilderton, Lilburn	1·92	49
„	Orton..............	4·85	123
XI.	Llanfrechfa Grange ..	..	..
„	Treherbert, Tyn-y-waun	9·06	230
„	Carmarthen Friary ..	..	..
„	Lampeter, Falcondale	3·49	89
„	Cray Station	8·50	216
„	B'ham W.W., Tyrmyndd	4·87	124
„	Lake Vyrnwy.......	5·10	129
„	Llangynhafal, P. Drâw	2·96	75
„	Oakley Quarries	6·41	163
„	Dolgelly, Bryntirion..	3·95	100
„	Snowdon, L. Llydaw.	..	..
„	Lligwy	2·28	58
XII.	Stoneykirk, Ardwell Ho.	1·44	37
„	Carsphairn, Shiel.....	3·21	81
XII.	Langholm, Drove Rd.	3·19	81
XIII.	Ettrick Manse	4·33	110
„	North Berwick Res....	1·58	40
„	Edinburgh, Royal Ob.	1·59	41
XIV.	Biggar...............	1·71	43
„	Leadhills	4·06	103
„	Kilmarnock, Agric. Coll.	2·00	51
XV.	Dougarie Lodge.......	2·03	52
„	Oban...............	2·45	62
„	Holy Loch, Ardnadam	.	..
„	Tiree Cornaigmore....	..	..
XVI.	Loch Venachar	3·80	97
„	Glenquey Reservoir ...	4·30	109
„	Loch Rannoch, Dall...	2·00	51
„	Blair Atholl	1·73	44
„	Coupar Angus....... .	1·73	44
„	Montrose Asylum	1·91	49
XVII.	Logie Coldstone, School	2·72	69
„	Fyvie Castle..........	2·22	56
„	Grantown-on-Spey ...	3·06	78
XVIII.	Kingussie, Fasnakyle..	..	..
„	Fort Augustus........	..	..
„	Loch Quoich, Loan ...	7·60	193
„	Fortrose	1·36	35
„	Faire-na-Squir........	..	..
„	Skye, Dunvegan	2·91	74
XIX.	Loch Carron, Plockton.	2·55	65
„	Dornoch, St. Gilbert's .	1·75	44
„	Tongue Manse	2·86	73
XX.	Melvich Schoolhouse ..	3·07	78
„	Dunmanway Rectory..	4·03	102
„	Mitchelstown Castle...	1·85	47
„	Gearahameen	7·40	188
„	Darrynane Abbey	3·72	95
„	Cashel, Ballinamona...	1·39	35
„	Roscrea, Timoney Pk..	1·94	49
„	Ballybunion..........	2·16	55
„	Broadford, Hurdlesto'n	2·35	60
XXI.	Kilkenny Castle.......	1·12	28
„	Rathnew, Clonmannon	1·64	42
„	Hacketstown Rectory .	1·96	50
„	Balbriggan, Ardgillan .	1·48	38
„	Drogheda	1·37	35
„	Athlone, Twyford	1·80	46
XXII.	Castle Forbes Gdns....	2·00	51
„	Ballynahinch Castle...	4·08	104
„	Galway Grammar Sch.	1·71	43
XXIII.	Westport House	3·43	87
„	Enniskillen, Portora...	1·84	47
„	Armagh Observatory ..	1·35	34
„	Warrenpoint	2·01	51
„	Belfast, Cave Hill Rd..	1·65	42
„	Glenarm Castle	2·10	53
„	Londonderry, Creggan.	2·27	58
„	Sion Mills...........	2·03	52
„	Milford, The Manse ...	1·87	47
„	Narin, Kiltoorish	2·51	64
„	Killybegs, Rockmount .	3·92	100

Correction—Clifton College, February, for "3·81/97" read "4·59/117."

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° F.
London, Kew Observatory	1022·1	+8·4	83	5	35	25	66·4	46·0	56·2	+6·3
Gibraltar	1017·7	+2·5	81	1	57	27, 28	74·1	65·7	69·9	+3·2
Malta	1019·5	+3·8	81	12	63	24, 30	74·7	66·6	70·7	+0·8
Sierra Leonè	1012·0	+0·1	91	2, 12, 18	70	30	87·5	73·7	80·6	+0·4
Lagos, Nigeria	1012·6	+0·9	88	10	71	2	85·9	74·9	80·4	+1·3
Kaduna, Nigeria	1014·1	+1·8	93	30	60	8, 12	88·6	64·6	76·6	−1·1
Zomba, Nyasaland	1011·1	+0·6	91	14	56	1	85·6	63·6	74·6	+0·5
Salisbury, Rhodesia	1010·2	−0·8	92	27, 28	48	8, 9	87·0	55·6	71·3	+0·5
Cape Town	1019·0	+1·6	82	18	44	11	68·4	51·2	59·8	−1·2
Johannesburg	1013·7	+0·4	83	26	45	15	74·5	53·1	63·8	+1·2
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	..	..	92	26	40	12	80·8	50·5	65·7	+1·1
Calcutta, Alipore Obsy.	1011·0	+1·6	91	6	63	31	86·4	73·4	79·9	−0·8
Bombay	1010·0	+0·3	91	19	73	31	89·3	77·3	83·3	+1·0
Madras	1009·4	+0·5	93	6	72	8	86·0	75·0	80·5	−1·6
Colombo, Ceylon	1009·9	+0·1	89	4	73	19	86·3	75·2	80·7	+0·2
Hong Kong	1015·9	+2·3	86	23	69	31	81·0	72·3	76·7	−0·2
Sandakan	..	..	90	14, 16	72	25	87·0	74·7	80·9	−0·6
Sydney	1015·8	+0·9	85	31	49	23	70·1	53·5	61·8	−1·7
Melbourne	1015·8	+1·2	86	30	39	7	66·2	48·6	57·4	−0·2
Adelaide	1016·5	+0·4	98	29	41	4	73·4	52·6	63·0	+1·1
Perth, Western Australia	1015·8	−1·0	81	2	41	20	69·5	52·1	60·8	−0·2
Coolgardie	1014·0	−1·2	90	23	37	14	76·6	50·6	63·6	0·0
Brisbane	1016·3	+0·1	85	22	51	3	77·2	58·0	67·6	−2·1
Hobart, Tasmania	1012·9	+2·3	81	25	36	6	61·0	44·9	52·9	−1·1
Wellington, N.Z.	1012·2	−0·1	66	7	42	27	59·6	50·2	54·9	+0·6
Suva, Fiji	1014·3	+1·1	86	22	63	2	84·6	68·3	76·5	+0·5
Kingston, Jamaica	1012·0	+0·1	92	3	68	30	88·1	72·7	80·4	−0·1
Grenada, W.I.	1008·8	−2·2	90	30	71	10	84·2	74·5	79·3	−0·8
Toronto	1014·2	−3·8	72	1	33	13	58·9	41·8	50·3	+3·4
Winnipeg	1013·2	−2·1	76	4	26	7	54·8	37·5	45·3	+4·5
St. John, N.B.	1012·2	−4·3	71	2	24	26	56·4	41·3	48·9	+3·6
Victoria, B.C.	1015·9	−1·7	73	10	39	23	56·6	45·6	51·1	+0·7

LONDON, KEW OBSERVATORY.—Mean speed of wind 4·6 mi/hr ; 15 days with fog.

GIBRALTAR.—2 days with thunder heard.

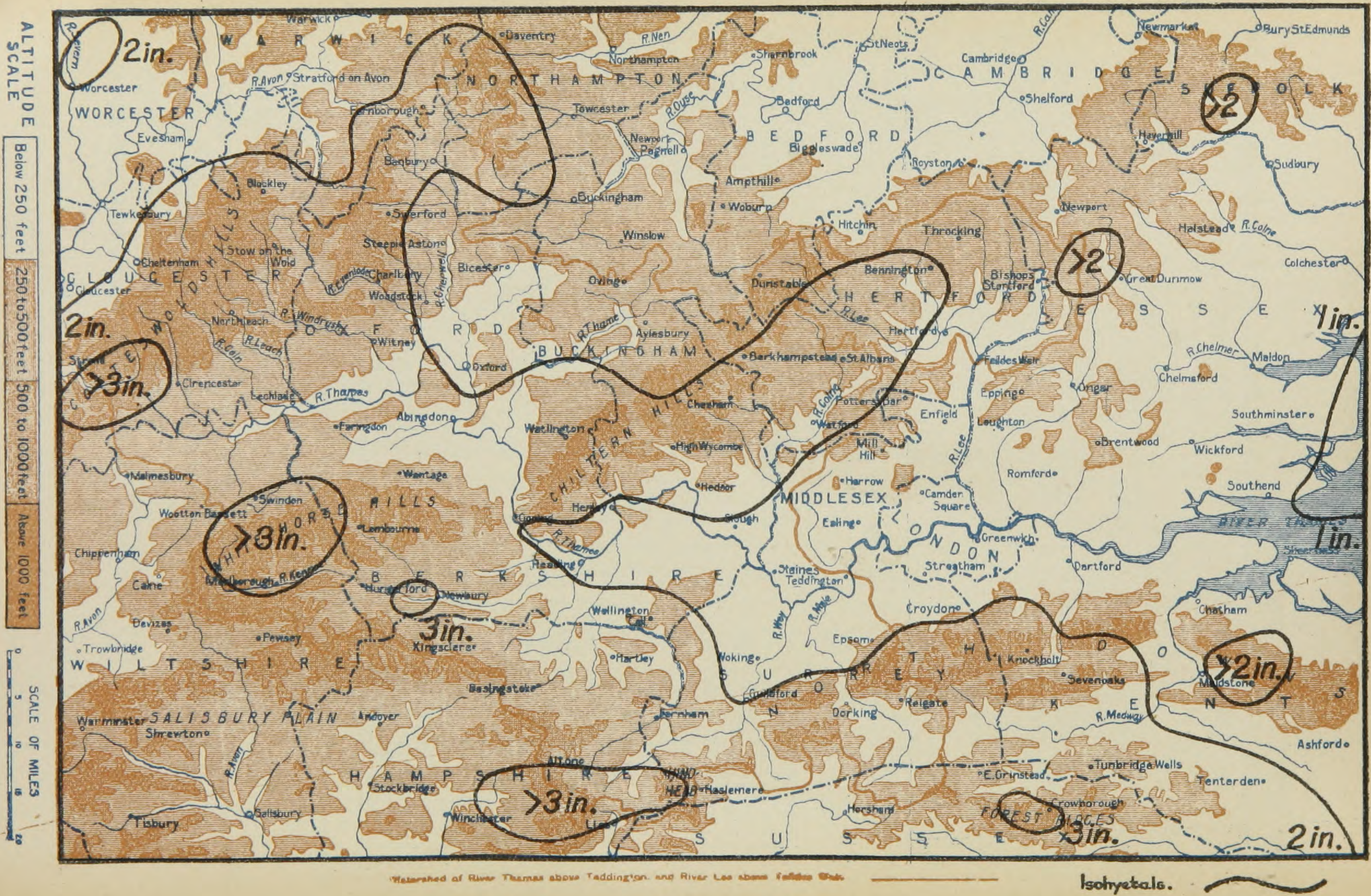
MALTA.—Prevailing wind direction E. Hours of obs. from this month are 7 h. and 18 h.

SIERRA LEONE.—Prevailing wind direction SW ; 7 days with thunder heard.

LAGOS.—Harmattan appeared on 26th.

SALISBURY, RHODESIA.—1 day with thunder heard.

THAMES VALLEY RAINFALL —— MARCH, 1922.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British Empire, October 1921.

TEMPERATURE		Relative Humidity	Mean Cloud Am'nt	PRECIPITATION				BRIGHT SUNSHINE		STATIONS
Mean Wet Bulb. °F.	Absolute Min. on Grass °F.	%	0–10	Amount in.	Amount mm.	Diff. from Normal mm.	Days	Hours per day	Percentage of possible	
53·5	27	77	5·1	0·44	11	− 58	7	4·9	46	London, Kew Observatory.
67·4	50	90	5·4	1·07	27	− 57	6	..	..	Gibraltar.
64·9	56	70	4·2	0·67	17	− 51	7	7·8	69	Malta.
75·7	..	75	5·6	5·31	135	−189	17	..	..	Sierra Leone.
75·5	69	83	8·8	3·74	95	−101	15	..	..	Lagos, Nigeria.
69·8	..	71	..	2·56	65	+ 5	7	..	..	Kaduna, Nigeria.
..	..	73	2·8	2·31	59	+ 21	6	..	..	Zomba, Nyasaland.
59·3	..	43	4·2	1·30	33	+ 3	5	..	..	Salisbury, Rhodesia.
55·6	..	63	4·8	1·21	31	− 13	11	..	..	Cape Town.
53·0	46	58	4·2	2·88	73	+ 12	9	8·6	68	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
53·7	..	47	4·8	0·49	12	− 31	5	..	..	Bloemfontein.
74·6	57	60	4·6	0·29	7	− 92	0*	..	..	Calcutta, Alipore Obsy.
76·2	59	69	2·8	0·06	2	− 45	2*	..	..	Bombay.
76·5	..	89	7·8	24·34	618	+332	18*	..	..	Madras.
77·3	71	72	8·5	8·44	214	−143	26	..	..	Colombo, Ceylon.
69·0	..	69	3·6	0·39	10	−115	4	8·5	74	Hong Kong.
76·8	..	84	..	12·51	318	+ 64	17	..	..	Sandakan.
56·7	40	62	4·3	3·10	79	+ 4	13	7·6	59	Sydney.
53·2	35	64	5·6	3·66	93	+ 27	13	..	..	Melbourne.
54·2	34	50	5·2	1·81	46	+ 2	11	7·3	57	Adelaide.
56·1	41	63	4·9	2·62	67	+ 13	13	8·2	..	Perth, Western Australia.
54·1	35	36	5·1	1·30	33	+ 14	4	..	..	Coolgardie.
61·4	45	59	3·9	1·36	35	− 34	9	..	..	Brisbane.
47·8	30	64	5·9	0·94	24	− 33	15	..	..	Hobart, Tasmania.
51·8	33	80	7·8	6·48	165	+ 58	18	4·4	33	Wellington, N.Z.
77·0	..	97	..	4·91	125	− 73	15	..	..	Suva, Fiji.
..	..	77	5·8	4·15	105	− 85	10	..	..	Kingston, Jamaica.
75·5	..	80	4·7	12·04	306	+120	24	..	..	Grenada, W.I.
44·5	28	82	5·5	4·46	113	+ 51	14	..	..	Toronto.
41·0	..	67	4·9	0·93	24	− 14	10	..	..	Winnipeg.
44·8	21	83	5·2	2·47	63	− 52	10	..	..	St. John, N.B.
47·0	29	81	5·7	4·74	120	+ 55	14	..	..	Victoria, B.C.

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

MADRAS.—13 days with thunder heard.

COLOMBO, CEYLON.—Prevailing wind direction WSW, mean speed 4·1 mi/hr. 3 days with thunder heard.

HONG KONG.—Prevailing wind direction E, mean speed 11·4 mi/hr.

SUVA, FIJI.—1 day with thunder heard.

GRENADA, W.I.—Prevailing wind direction E ; 1 day with thunder heard.

(*Continued from p.* 83.)

period 1886–1917 no cyclone travelled as far west as the mouth of the Zambesi during any month and none reached the coast in February.

The rainfall of the month was again below the average generally, although the actual distribution of rainfall was normal in type, especially, in England, where only small areas had rainfall differing from the average by more than 20 per cent. In Shropshire, Hereford and the Devon-Cornwall peninsula more than 20 per cent. in excess was recorded. The area with rainfall above the average was mainly in the south-west of England and Wales and along the east and south coasts from about Boston to Hastings. Less than the average occurred in the centre and north of England and Wales, but nowhere was the deficiency large. In Ireland the distribution of rainfall was normal, but the amount was everywhere deficient. Less than half the average was recorded in the extreme south-east, and the eastern half generally had less than 75 per cent. of the average. In Scotland there was a small deficiency nearly everywhere, but the fall was apparently nowhere less than half the average. The month was not conspicuous for any very heavy falls on one day. The number of rain days was practically everywhere more than 10, by far the greater part of the country having more than 15 days with rain.

The general rainfall for March, expressed as a percentage of the average was:—England and Wales, 103; Scotland, 76; Ireland, 72; British Isles, 86.

In London, Camden Square, the mean temperature for March was 41·8° F., or 0·3° F. below the average; the duration of rainfall, 42·2 hours; and the evaporation, ·96 inch.

News in Brief.

WE regret to announce the death on April 2nd of Dr. H. N. Dickson, sometime Professor of Geography at University College, Reading, and formerly President of the Royal Meteorological Society. It is hoped to publish an obituary notice in the May number of the Magazine.

THE Bergen Museum has equipped a vessel, the *Arnauer-Hansen*, for deep-sea exploration in the Atlantic. The expedition will start at the end of April under the leadership of Professor Helland-Hansen.

Erratum.—With reference to the note on *Frequency of Fog in the English Channel*, published last month, pp. 47 and 48, it should be stated that Longships is a lighthouse, not a light-vessel.

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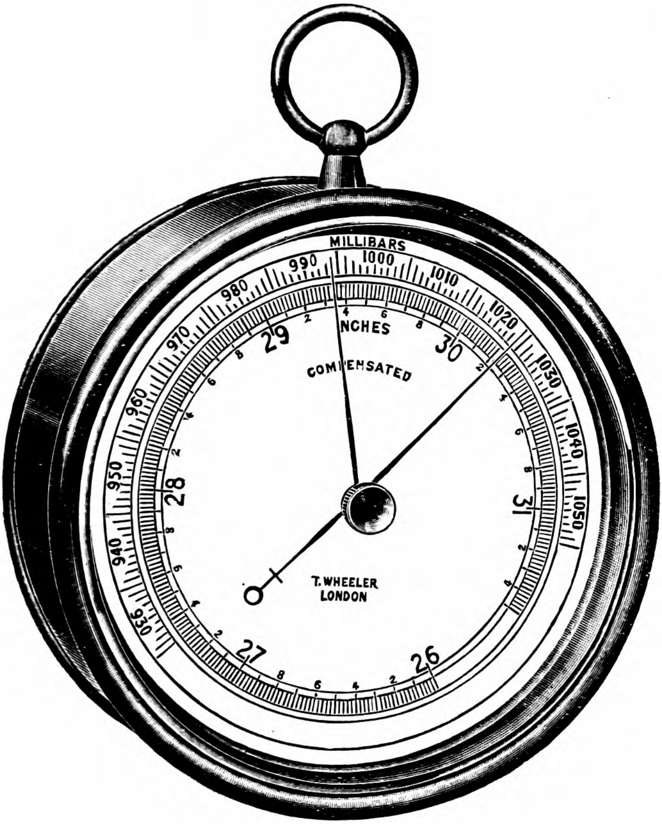
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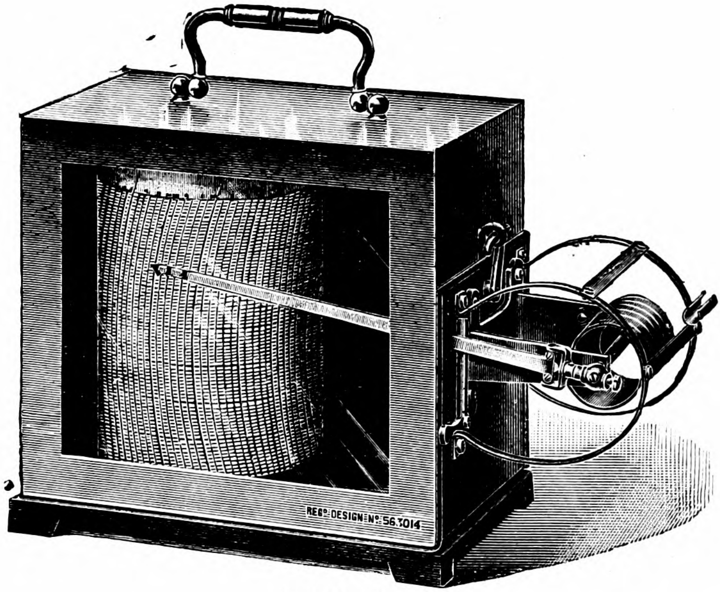

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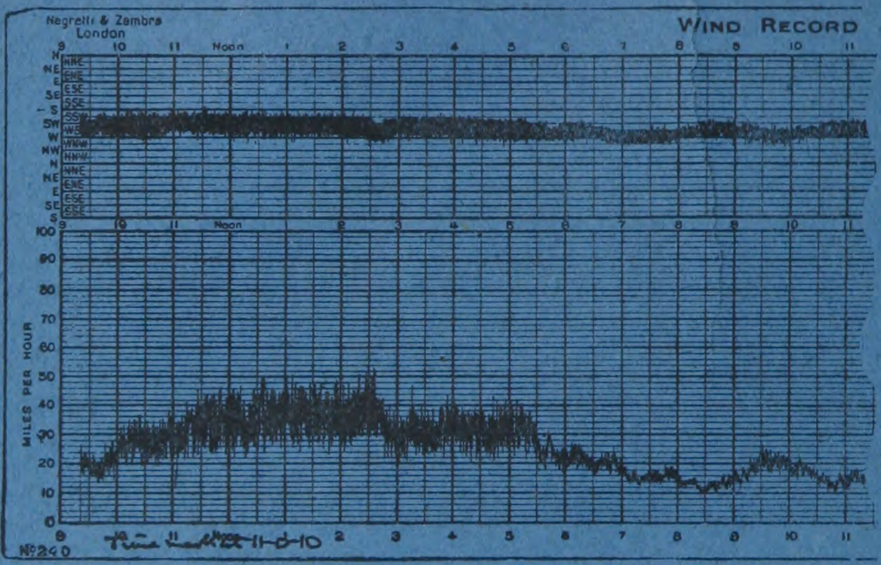

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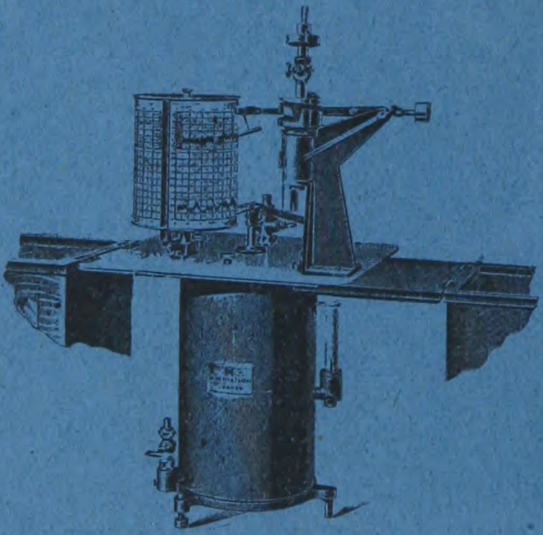

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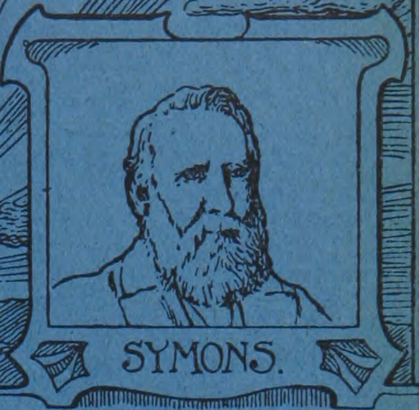

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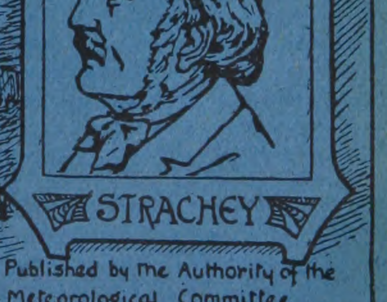

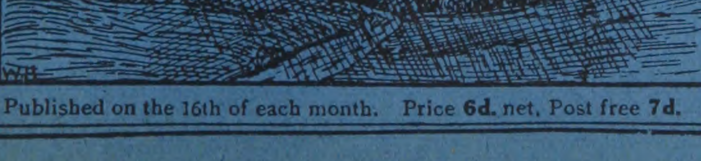

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The responsibility for all facts and opinions expressed in the signed articles and letters published in this Magazine rests with their respective authors.

MAY 1922.

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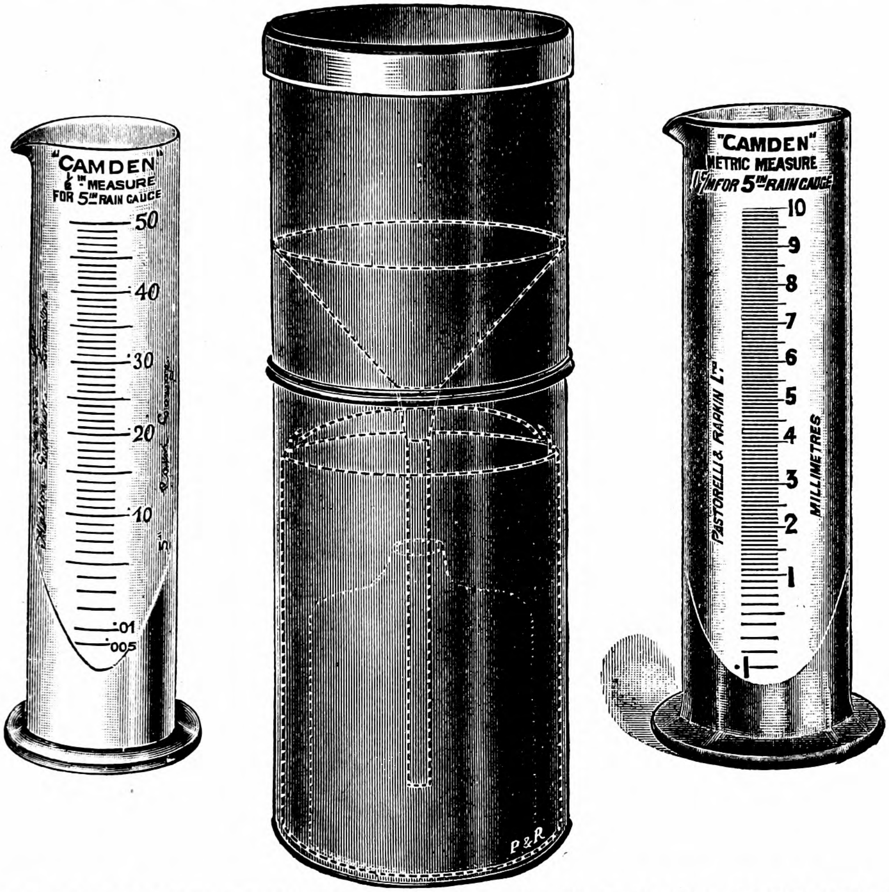

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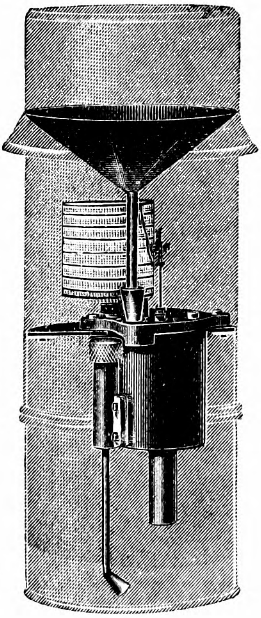

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New Light on the Significance of Wet Bulb Temperature.

By F. J. W. WHIPPLE, M.A., F.Inst.P.

THE reading of the wet bulb thermometer has generally been regarded by meteorologists as a means to an end, the determination of the amount of moisture in the air, of vapour pressure and of relative humidity. We have known that in hot countries importance was attached to the wet bulb readings as giving a measure of the discomfort of a climate, but we have not asked whether a definite physical property of the air was indicated by the wet bulb reading without reference to the simultaneous dry bulb reading.

It has long been realized that if the wet bulb reading was to be used for accurate hygrometry it should be obtained with a good air flow past the bulb. The flow must be so vigorous that the heat communicated to the evaporating surface by the air is large compared with that received by radiation from surrounding bodies and by conduction down the thermometer stem. This condition is satisfied when the air flow is ten miles an hour or more; it is not satisfied as a general rule when a hygrometer is installed in an ordinary room or in a Stevenson screen. With the well ventilated thermometer the heat taken from the air provides the latent heat of evaporation of the water. According to the theory of Apjohn and August the portion of air which gives up its heat is saturated in the process. It is more correct to say that in the air streaming over the moistened bulb the diffusion of heat inwards and vapour outwards balance, and G. I. Taylor (1), who has adapted the theory of Clerk Maxwell (2) points out that it is only on account of a fortunate numerical agreement between the ratio of diffusion of heat and water vapour in air that the wet bulb serves its

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purpose so well. " Wet bulbs " moistened with liquids other than water do not conform to the same simple rules. It is to be hoped that this work of Taylor's, theoretical and experimental. will be published before long.

The point of immediate interest is that the well ventilated wet bulb does give the same temperature as is reached when the air is supplied with all the water that it can take up. This fact is demonstrated on a large scale in the installations which are supplied by the Carrier Engineering Company for humidifying or dehumidifying the air, and in which water is sprayed from fine jets into air-ducts. Given air with a certain wet bulb temperature and sprays at that temperature the product is saturated air at the same temperature. The dry bulb temperature is of no account.

Mr. W. H. Carrier (3) sums the matter up in the statement :—

> " For a given temperature of evaporation—that is, for a given wet bulb temperature—a pound of air contains a fixed and definite amount of heat, regardless of the dry bulb temperature or of the moisture contents. This means that the wet bulb temperature is the rational and convenient measure of the total heat content of the air, both latent and sensible."

Now consider the climatic problem. The skin of the healthy man in a hot climate is continually moistened by perspiration; the hot air which comes in contact with the skin takes up the moisture. The extent to which a given volume of air flowing over the skin is effective in taking away superfluous heat from the body depends on the difference between the temperature of the skin and the wet bulb temperature. The heat loss goes to provide the latent heat of evaporation and to warm up the air above the dry bulb temperature. The heat which becomes latent when a certain mass of air is being saturated is the same as the heat required to warm that mass from the wet bulb temperature to the dry bulb temperature. Accordingly the total heat loss of our perspiring human being is sufficient to warm the air from wet bulb temperature to dry bulb temperature, and from dry bulb temperature nearly to skin temperature. Evidently the dry bulb temperature is comparatively unimportant, it may even be above skin temperature (so that the second of these two processes is reversed and partially cancels the first), though in that case the amount of water which must be drunk and sweated away is excessive. The part played by the lungs in the human economy must be controlled in like fashion by the wet bulb temperature.

In a recent discussion at the Physical Society Dr. Simpson (4) gave some account of an investigation by Dr. C. W. Normand concerning the relation of wet bulb temperatures to the thermodynamics of air. Dr. Normand's paper (5), which has now been published, contains many propositions of great importance. It is shown, for example, that if two air masses start from the same sea level pressure and the same wet bulb temperature and both are carried to a higher level with no exchange of heat by radiation, etc., they continue to have equal wet bulb temperature, and this is true to a close approximation even when condensation has begun in one air mass or in both. The fact that the wet bulb changes obey the same law, whether condensation is taking place or no, provides a criterion by which the identity of an air current may be tested. As one of his examples, Normand considers the case of a typhoon in which the central region was calm, warm and dry. The wet bulb temperature was the same in this region as in the stormy belt around it and it is concluded that the air was drawn from the same source. The same test serves to discriminate between two types of thunderstorms, the winter storms in which instability is due to the superposition of air currents from different regions, a cold current above a warm one, and the summer storms in which instability is due to processes of a local character.

The moral to which all this discussion points is that we ought to abandon the use of the more-or-less-ventilated wet bulb in hygrometry. There are two ways in which a sufficiently vigorous movement of the air relative to the wet bulb can be obtained. Either the bulb can be moved through the air or the air can be sucked past the bulb. As to the former alternative, various ways of mounting thermometers so that they may be whirled round with safety have been devised. As to the latter, the aspiration of air past the thermometer bulb dates from 1852, when John Welsh (6), later the Superintendent of Kew Observatory, devised the method for use in balloon ascents. In the well-known Assmann psychrometer (7) a clockwork fan draws the air past the bulbs.

The cost of the installation of well-ventilated wet bulbs and the additional trouble entailed in their use will be repaid by confidence in the utility of the readings and by an appreciation of their significance.

BIBLIOGRAPHY.

A bibliography of the more important papers on hygrometry from 1783-1901 is given in the introduction to Jelinek's *Psychrometer-tafeln*, Leipzig, 1903. A selection including some later papers has been made by Dr. Ezer Griffiths in connection with the Discussion on Hygrometry, *Proceedings of the Physical Society of London*, Vol. XXXIV., Part II., Feb. 1922, p. xciv.

Taylor's formula (1) is given on p. xci. of the same Discussion and Dr. Simpson's account (4) of Normand's work is summarized on p. lxxi. Dr. Normand's paper (5) is now published as Part I., Vol. XXIII. of *Memoirs of the Indian Meteorological Department*, 1922. Clerk Maxwell's theory of the wet bulb thermometer (2) is to be found in the article on *Diffusion* in the *Encyclopædia Britannica*, 9th ed. 1877, Vol. VII., p. 218. Mr. W. H. Carrier's paper (3) *Rational Psychrometric Formulæ* was published by the *American Society of Mechanical Engineers*, Dec. 1911. John Welsh's psychrometer (6) is described in his paper, *An Account of Meteorological Observations in Four Balloon Ascents*, published in the *Phil. Trans.* of the Royal Society, Vol. XII., 1853, p. 313. References to Assman's psychrometer (7) may be found in the bibliographies mentioned above.

(The numbers refer to the figures in the text.)

The Development of Water Resources.

By M. DE CARLE S. SALTER.

THE final Report of the Water Power Resources Committee of the Board of Trade appears at a most opportune moment. The public is beginning, we believe, to awake to the fact that the present haphazard utilization of the natural water resources of the country, and the almost entire neglect of water as a source of energy for economic purposes, are not only wasteful, but in a large measure preventable. It is becoming every year more evident that we cannot afford, as a nation, to tolerate a condition of affairs which is admitted, by all who have given the matter their close attention, to be capable of considerable improvement, but which it becomes less and less possible to amend with the lapse of time.

The original terms of reference of the Water Power Resources Committee, which was appointed in June 1918, were: "To examine and report upon the Water Power Resources of the United Kingdom and the extent to which they can be made available for industrial purposes." A sub-committee was appointed by the President of the Board of Trade in November 1918 for the purpose of dealing with a similar enquiry with reference to Ireland, and although the latter body has acted independently of the main Committee, it is useful to know that the recommendations of the two, except in respect of certain legislative matters, are practically unanimous.

In October 1919, the terms of the original reference were enlarged by the following instructions: "To consider what steps should be taken to ensure that the Water Resources of the country are properly conserved and fully and systematically utilized for all purposes." The enlarged reference afforded to the Committee an opportunity of calling attention to the shortcomings of the existing system of granting powers to utilize sources of water supply which they were not slow to seize. The interests which require to be considered, particularly in England and Wales, when any water undertaking is put in hand, are numerous and complex, and amid the clamour of their uplifted voices the corporate interest of the nation is often apt to go unheard. There is no question that the Committees of Parliament charged with the duty of reconciling these interests have endeavoured to act with strict impartiality and with a commendable public spirit, but no system of changing lay administrators, even with the help of the several Acts revised for their guidance, can be expected to produce a well-balanced and co-ordinated whole.

In order to meet the need of a skilled tribunal, which shall have in mind, not only the claims of the parties immediately before it, but the efficient administration of the whole water resources of the country in a way which would be impossible to any but experts, the Committee examined first of all the possibility of setting up a Central Water Department. It was found, however, that water interests overlapped existing Departments too much to admit of this solution. It is, therefore, proposed that there should be set up by statute a Water Commission, having jurisdiction over England and Wales, for the purpose of controlling the allocation of Water Supplies. Similar duties in regard to Water Power it is proposed shall devolve upon the Board of Trade or the Electricity Commissioners.

The duties with which the proposed Water Commissioners are to be charged are, among others, the allocation of water resources and the re-adjustment of existing allocations, always subject to Parliamentary sanction, and to render assistance to Parliament in similar duties. Secondly, to divide the country into natural areas and to appoint Watershed Boards* in substitution for the various local authorities now concerned with different water interests. Thirdly, and it is in this respect that we, as meteorologists, are mainly concerned, to carry out a complete hydrometric survey of the country.

In order to ensure the fullest co-operation between the Water Commission and the Departments interested in water matters, it is proposed to institute an Inter-Departmental Committee comprising representatives of the Departments in question and of the various scientific services. Meteorology will be represented in respect of the fundamental importance of a knowledge of the distribution of rainfall. The survey in question involves a complete tabulation of existing and potential water resources and of geological data relevant thereto, the completion of an accurate large scale rainfall map, and a study of the run-off of streams. The Committee recognizes to the full that the data demanded for the proposed survey are already partly collated and are likely to be most efficiently brought together by the experts already dealing with such subjects, and it is hoped to utilize all existing organizations and to pool available knowledge by means of Advisory Committees including representatives of the technical professions and of the scientific societies.

Special stress is laid upon the necessity of completing at the earliest possible date a trustworthy large scale average rainfall map of the British Isles. Such a map, it is pointed out, is only made possible by the voluntary work of the observers of the British Rainfall Organization. We believe that the majority of the rainfall observers have carried on their patient work with little thought beyond the immediate interest of the observations. Others, no doubt, have realized that their records ought, at any rate, to be utilized as data in economic problems. A few, probably, know that the collective work of the many thousands of observers has for long formed the starting point of all well-regulated water undertakings and that it constitutes the finest collection of information on a single branch of hydrology available for any country or any period. That these statistics should be appealed to, and that the general knowledge of water economy in nature which they have made possible, should be brought to bear on the present problem is inevitable.

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* The snub administered to the Commission by the Director of the Ordnance Survey for misusing the word "watershed" when "river basin" is intended provides a touch of humour seldom encountered in blue books.

For the purpose of getting to close grips with their subject, the Committee set out a well-devised scheme for the sub-division of the country into areas suitable for hydrometric study and water administration. It is satisfactory that as the primary basis for this sub-division the river basin is the chosen unit, rather than the county or any other administrative area. In selecting the river basins which shall be dealt with either individually or in groups, the Committee have adopted the arrangement which was designed by Dr. Mill in 1910 for use in *British Rainfall.* All the records sent to the British Rainfall Organization are now grouped in accordance with this scheme and the work of co-ordinating the rainfall survey with the general plan of the hydrometric survey should thus be immensely facilitated.

The interest of meteorologists in the work of the Committee will undoubtedly centre largely round the application of rainfall data to the solution of the problems discussed, and in a less measure the invaluable proposal to bring together the scattered and in some cases inaccessible information on the flow of streams

In regard to rainfall we are well prepared. Sufficient data exist for most of the districts in question, and where they do not exist general knowledge can to some extent supply the need. It is, however, important to point out that the areas in which direct information for water-supply and water-power purposes is most urgently needed are just those in which the population is most scanty, in other words, where rainfall stations are fewest. This difficulty becomes one of serious magnitude when we are dealing with the potential water-powers of districts like the Scottish Highlands. In these districts, the rainfall is not only very large, but extremely variable. Owing to the difficulty of supporting life in the wild glens, the population is extremely small. It is probable that the preservation of large deer-forests or other shootings may have contributed in some measure to this, but whatever may be the cause, it is extraordinarily difficult to procure rainfall records. From the actual mountains it is in most cases virtually impossible. Sufficient is known of the natural control of rainfall to enable a very small number of mountain records to be applied to the problem of computing the mountain rainfall from that in the neighbouring glens, but these few must be absolutely trustworthy. The difficulties in the way of obtaining completely accurate records on exposed mountain slopes are greater than the inexperienced person would think, but with a reasonable amount of care and trouble it can be done. The Highland gillie makes as a rule an excellent observer and with a system of expert inspections at fairly frequent intervals, much may yet be done. It must, however, be recognised that if accurate knowledge of the rainfall of the Scottish mountain areas is to be acquired, no time must be lost. Rainfall observations for a few months prior to the launching of a great scheme are no doubt much better than nothing; but several years' records are essential if a determination of the average fall is to be free from risk of serious error.

The fact is often not fully appreciated by landowners that the water on their estates is a valuable asset and that when the time comes to utilize it, a knowledge of the amount of rainfall is of immense assistance in enabling that value to be fully realised.

The time is far spent—we would urge once more that those who have the means at their disposal for setting up rainfall observations in these remote districts which will soon become of such vital importance, will redeem it ere it be too late.

We have not dwelt upon the collateral problem of the recording of run-off of streams, because, although it is in some respects of even more importance than the rainfall problem, it is of less direct meteorological significance. In other words, the science of meteorology is concerned with the atmosphere rather than the earth and we must look to the geographer, the geologist and the engineer to provide the data which constitute the next link in the chain of Nature's water-cycle. We hope, however, to deal later with some of the practical results of the enquiry from the point of view of utilizing the flow of streams for hydro-electric purposes.

We have left ourselves little space to mention the aspects of the Report of less immediate meteorological interest. It is, however, of importance to notice that suggestions are made for the improvement of the law as to the granting of Compensation Water and that it is urged that the improvement of the inland navigation of the country should be taken in hand, more particularly in regard to the aspects in which the canal system bears upon water-supply. The interests of fisheries are also dealt with in some detail.

OFFICIAL NOTICES.

Meteorological Office Publications.

The reserve of British Rainfall, 1911, has been exhausted. The Director of the Meteorological Office would be glad to hear from any reader who has a copy which he does not require and which he could spare to be added to the stock held to meet demands on the Office.

Copies of the following issues of the Monthly Weather Report are also required:—Annual Summary, 1906; January to September, inclusive, 1907.

International Balloon Ascents.

A GENERAL scheme of dates for International Balloon Ascents for the next 7 years was fixed at the meeting of the International Commission for the Scientific Investigation of the Upper Air at Bergen in 1921. The dates for the year 1922 under this scheme were published in the *Meteorological Magazine* for February 1922, p. 20.

Attention has recently been drawn to the fact that the meeting of the members of the International Meteorological Committee in London in 1919 recommended that, as far as possible, special international investigation of the upper air should be made in co-operation with Roald Amundsen's expedition during the years 1919–1924. The following are the dates then selected for the year 1922:—

January	5th.	July	5th–7th.
February	2nd.	August	3rd.
March	8th–10th.	September	7th.
April	6th.	October	5th.
May	8th–10th.	November	1st–3rd.
June	8th.	December	7th.

These dates are to be regarded as supplementary to, and not in substitution for, the dates selected at Bergen and upper air observations should be made on these "Amundsen" dates wherever it is possible to do so without prejudice to ascents on the dates of the general scheme. It will be observed that in May the two sets of observations are practically continuous for a fortnight.

It is stated that the Lindenberg Aerological Observatory has, since 1919, arranged series of several ascents per day, the ascents being evenly distributed over the 24 hours of each day over a period of some weeks. Such frequent ascents are now being made during all the weeks which include international observations.

Official Publications.

Professional Notes No. 27.—A Gazetteer of Meteorological Stations of the First, Second and Third Order. (Introduction and specimen pages.) By H. N. Dickson, C.B.E., M.A., D.Sc. 10 pp. 1921. Price 4*d.* net, postage 1*d.*

DURING the war a gazetteer of meteorological stations of the first, second, and third order was prepared by the Geographical Section of the Naval Intelligence Department, Admiralty, under the direction of the late Dr. H. N. Dickson. The cost of printing at the present time being very heavy, it has been decided not to print the gazetteer but to publish the introduction and two specimen pages in order to show the kind of information available for reference.

The manuscript is kept in the Library of the Meteorological Office, and may be consulted by arrangement with the Director of the Meteorological Office.

The Royal Meteorological Society.

THE monthly meeting of the Society was held on April 19th, at 49, Cromwell Road, South Kensington, Dr. C. Chree, F.R.S., President, in the chair.

Two of the papers which were presented dealt with the investigation of the correlation coefficients between certain meteorological elements.

W. T. Russell.—The relationship between rainfall and temperature as shown by the correlation coefficient.—Mr. Russell's primary interest is in the bearing of weather on the causation of disease. The analysis of the relation between rainfall and temperature of one month, of rainfall and temperature for successive and for alternate months was carried out as a preliminary. The data utilised referred to Greenwich, Greenock, Dundee and Glasgow. The principal results obtained were as follows :—

(1) The correlation coefficient for the temperature of successive months is approximately + 0.3.

(2) There is no definite relationship between rainfall in successive months.

(3) Rainfall in alternate months shows some fairly high correlation coefficients. For example, the coefficient found between the rainfall of June and that of August in London is as high as + 0·55. (As was pointed out in the discussion, this result is unexpected and must be received with caution.)

(4) There is a well marked negative correlation between rainfall and temperature in summer and a positive correlation in winter.

R. A. Fisher, M.A., and Winifred A. Mackenzie, B.Sc.—The correlation of weekly rainfall.—The rainfall at three stations, Aberdeen, York and Rothamsted having been correlated for each week of the year, the correlation coefficients were smoothed by a process involving considerable mathematical ingenuity. As was to be expected, the correlation between the rainfall at any two of the three stations is high in winter, low in summer. The ranges obtained after smoothing were as follows :—

	Max.	Week.	Min.	Week.	Mean.
Aberdeen and York	·64	9th	·38	28th	·53
York and Rothamsted -	·68	6th	·49	26th	·59
Aberdeen and Rothamsted	·53	6th	·22	24th	·37

As was pointed out by more than one speaker in the discussion, the high positive correlation obtained throughout must depend largely on the fact that all the three stations under consideration are on the eastern side of Great Britain.

Prof. S. Chapman, F.R.S., and Miss E. Falshaw, M.Sc.—The lunar atmospheric tide at Aberdeen, 1869–1919.—Prof. Chapman has previously published investigations of the tides produced in the earth's atmosphere by the gravitational attraction of the moon. He has utilised the records of Greenwich and of stations in the tropics. In the present paper the tabulations, published and unpublished, of pressure at Aberdeen have been analysed. The series of observations available was somewhat shorter than that for Greenwich—54 years as against 64 years—and as Aberdeen is more disturbed, the probable error of the result is rather greater for Aberdeen. The phases of the tide at the two stations agree as well as can be expected, while the Aberdeen amplitude, 0·0188 mb., is considerably greater than that at Greenwich, 0·0121 mb.

Correspondence.

To the *Editors, "Meteorological Magazine."*

The Sun and the Weather.

I GATHER from Mr. Deeley's letter in the March number of the *Meteorological Magazine* that he has misunderstood Father Cortie's statement concerning the characteristics of the magnetic field in 1920 and 1921. There may have been more magnetic disturbance at Stonyhurst in 1921 than in 1920 in the sense that the mean daily range of magnetic force was greater.

The *proportional* change in the absolute value of magnetic force at any station is very small from year to year, and if the horizontal (or any other) component is increasing in one region, it is decreasing in another. Whether the earth's magnetic moment is altering at all is one of the many unknowns of science. But if it does vary, the change from year to year is certainly too small to possess significance in connection with the fate of electrons shot out from the sun.

The truth or otherwise of the assertion in Mr. Deeley's last paragraph is at present a matter of opinion.

C. CHREE.

Kew Observatory, Richmond, April 1922.

Weather Lore.

I NOTICE in the March number of *The Meteorological Magazine* that Commander Brooke Smith suggests the Bristol Channel above Minehead as a good place to study the variations of wind with tide. In a letter written to this Magazine in September 1919, I gave some of the chief phenomena in connection with wind and tide in that district, from experience gained at all times of the year and in all weathers. It is essential to be on the sea to notice the changes, as frequently there is no apparent variation on shore. However, on occasions of little wind, it very often happens that the progress of the flood-tide up Channel can be followed from the cliffs by watching the advancing line of " wind-billow," on the surface of the sea, coming from west or north-west; the wind comes up about the time a boat at anchor begins to swing to the " young flood," after the " slack " of low-water.

Of course, most of these changes can best be noticed during the summer months. The curious thing is their variety—westerly winds up Channel appear usually to freshen on the flood, although in the case of sea-breezes from west-north-west to north-west the tendency is just the reverse. Easterly winds are more constant, and usually freshen on the ebb, especially inshore, although some miles off the coast this is not very apparent.

These remarks refer wholly to about twenty miles along the west Somerset coast. Changes in the temperature of the water, and friction, undoubtedly contribute to these phenomena, but the temperature differences must be very small.

T. F. TWIST.

Fawley, Hants. March 31st, 1922,

Solar Halo observed at Eskdalemuir, March 15th, 1922. An Arc of Unrecognized Character.

THE halo illustrated on the plate opposite was observed at 10h. 45m. on March 15th. The sky at the time was about half-covered with cirro-stratus and thin haze. The cirro-stratus took the form of thin parallel bands running approximately east-north-east to west-south-west, while immediately below it there appeared to be another layer of a cirro-stratus type taking the form of a very thin haze.

The halo was of good definition and the following points were noted :—

(*a*) Parhelia appeared on both sides of the circle, but not within its circumference, the left or eastward of these being considerably brighter than its fellow.

(*b*) An ill-defined arc of contact with upturned ends could at times be seen at the top of the circle.

(*c*) At the bottom, the halo was exceedingly brilliant and showed colours ranging from orange on the inside of the ring to pale green on the outer edge.

(*d*) About midway between the eastward parhelion and the bottom of the circle a down-turned arc joined the circumference on the outer edge.

The arc was distinctly visible for some 20 minutes. Not until 11h. 5m. did a thickening of the ring on the westward side give any indications of a corresponding arc. The thickening which was similar to that observed in the solar halo* of 20th April 1921, was unmistakable, but it was not possible to distinguish any definite arc.

The halo continued visible for nearly an hour, but the parhelia and arcs disappeared and fracto-stratus finally intervened.

Measurements were made by aligning the sights of a pilot balloon theodolite. The principal dimensions were as follows :—

Elevation of the sun	29° 1.
Radius of the halo	22°
Elevation of the intersecting arc	18° 9
Radius of the intersecting arc (the centre being the lowest point of the halo)	22°

P. F. JARROLD.

Eskdalemuir Observatory, April, 1922.

[The arc observed by Mr. Jarrold is new to us. It does not occur in the comprehensive paper : *On the Arc of Lowitz and Allied Phenomena,*† by S. Fujiwhara and S. Oti, which includes the examples collected by Bravais, Pernter, and Besson as well

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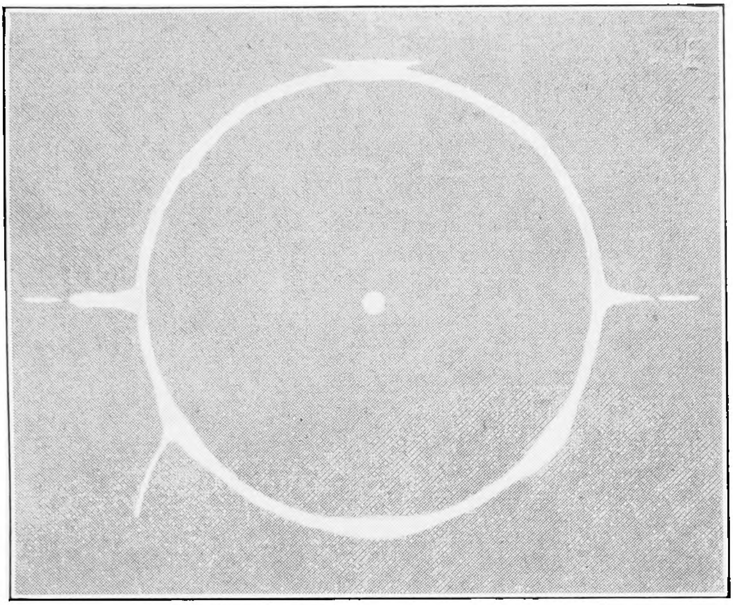
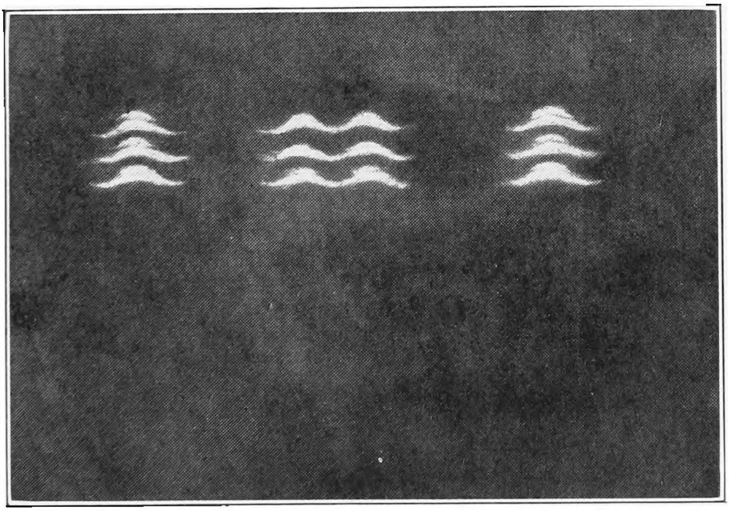
* *Meteorological Magazine,* Vol. 56, June 1921, p. 128.

† *Bulletin of the Central Meteor. Obsy. of Japan,* Vol. III., No. 1, 1919.



A SOLAR HALO OBSERVED AT ESKDALEMUIR.
MARCH 15TH, 1922.



AN UNUSUAL CLOUD STRUCTURE OBSERVED AT FELIXSTOWE.
MARCH 1ST, 1922 (*see p.* 105).

as recent illustrations from the United States *Monthly Weather Review.*—Ed. M.M.]

Unusual Wind Structure at Eskdalemuir.

Two pilot balloon ascents at Eskdalemuir on the morning of March 25th disclosed a wind structure of some interest, close to the trough of an elongated depression which extended from beyond the Hebrides to eastern England. At 7h. 30m. there was a west-north-west current up to 8,000 feet, the highest velocity being 11 miles per hour at 2,000 feet. Above 8,000 feet the wind backed quickly, and from 11,000 feet upwards it was south-south-east, increasing in velocity up to 40 miles per hour at 17,000 feet, where the balloon was lost. Nephoscope observations of cirrus-cloud motion showed that the velocity increased still further at greater heights, without appreciable change of direction. Three hours later the wind structure was similar, except that the lower wind was lighter and began to back about 5,000 feet; above 13,000 feet the wind had backed 10° since 7h. 30m. A computation of the horizontal gradient of temperature between 4 and 5 kilometres (13,100 and 16,400 feet) above mean sea level, based on the wind structure disclosed by the second balloon, showed that the mean temperature between these levels fell towards south-west at the rate of 2·7° C. per 100 kilometres, or 7·8° F. per 100 miles. The explanation of this temperature gradient can readily be seen from the synoptic charts. Over the south-western half of the British Isles there was a cold north-westerly current with heavy hail showers and local thunder, and these conditions always mean very low temperatures aloft. Over the North Sea there was a south-south-east current which was also cold at the surface, but up above one would expect to find air originally from the "warm sector" of the cyclone. The cyclone had recently become surrounded by polar air, and it began to fill up 12 hours later. Just behind such elongated depressions there is normally a strong upper current from south-south-west or south, but only rarely from south-south-east. There are, however, some cases on record of wind structure similar to that of March 25th.

C. K. M. Douglas.

March, 30th, 1922.

[The method of computation mentioned by Capt. Douglas is due to Sir Napier Shaw.* It is based on the principle that if the wind aloft differs from that below there must be a corresponding difference in the pressure distribution and that this is due to the lower layers being colder and denser in one region than in another. The air aloft goes cyclonewise round a cold area.—Ed. M.M.]

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* *Manual of Meteorology,* Part IV, Chap. VII. *See also* Q.J.R. Met. Soc. 1914, Vol. XL, p. 112.

NOTES AND QUERIES.

The Gale of March 7th—8th, 1922.

THE autographic records on the opposite page have been reproduced in order to show further details of the gale of March 7th–8th, which was described in last month's magazine, p. 81.

An interesting feature is the second rise in wind speed at Pendennis Castle between 5h. and 6h. Neither Scilly nor Plymouth records show this. There is no corresponding change in wind direction, but a rise in temperature is associated with the increased wind velocity. The temperature rise occurs shortly before the increase in velocity in each case.

The highest gusts recorded were 48 metres per second (108 miles per hour) at 3h. 40m., at Scilly, and 46 metres per second (103 miles per hour) at 3h. 30m., at Pendennis Castle.

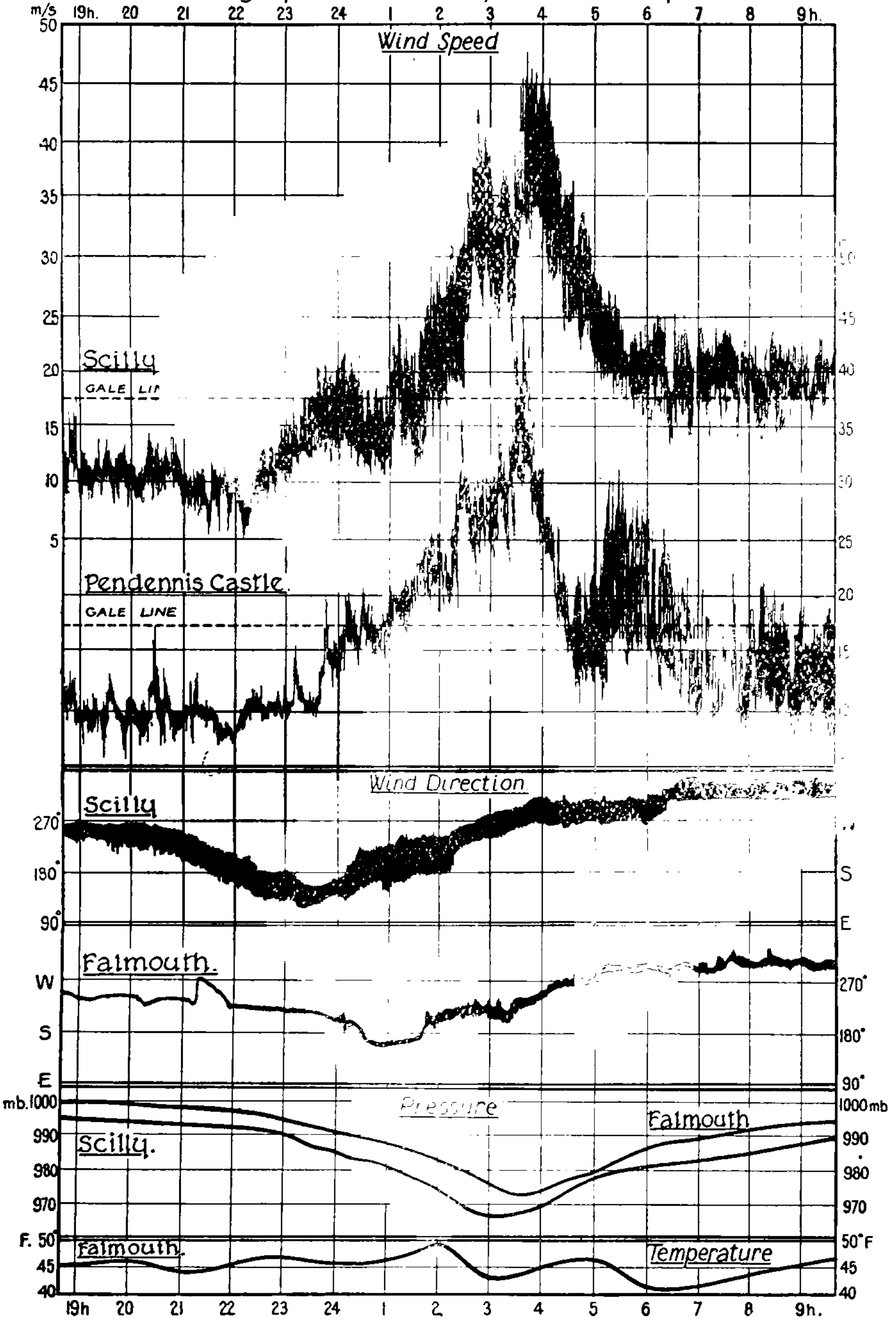
The gust at Scilly is the highest ever recorded in England and the highest but one recorded in the British Isles.

The gust at Quilty, Co. Clare, on January 27th, 1920, which carried the pen beyond the edge of the chart, indicating 110 miles per hour, is accepted as the highest on record. This excursion of the pen was isolated, however, and there is room for doubt as to its interpretation. It should be mentioned also that the pressure-tube anemometer at Scilly is not in exact adjustment and that the curves have not recently been accepted for the wind analysis for the *Weekly* and *Monthly Weather Reports.* The error, which displaces the zero by two or three miles per hour, may affect the record at the top of the scale by such an amount.

The Abnormal Distribution of Sunshine during March 1922.

THE distribution of sunshine during March 1922 shows some interesting irregularities. The normal map of sunshine for March indicates a gradual decrease from 4·5 hours per day along the south coast of England, to less than 3·5 hours per day in western Scotland and northern Ireland; also relatively high sunshine along the east coasts of Scotland and England. During the month under review, the highest values obtained generally in the west and north-west, thus constituting an almost complete reversal of type. An examination of the pressure map throws light on the anomaly, the highest pressure being found to the west of Ireland and the lowest over the North Sea. The high sunshine values over Ireland thus coincide with

Autographic Records, 7th-8th March, 1922.



the anticyclonic area, but the explanation only partially suffices. The deficiency of sunshine around Moray Firth, along the Yorkshire coast, on the north coast or Norfolk and around the coast of Kent is significant; in fact, east coast stations with a northerly or north-easterly aspect have low sunshine values. On the other hand, where the aspect is south-east the sunshine is greater, relatively high values being found around the Firth of Tay and along the coast of Essex. A similarity of distribution may also be seen in the Isle of Wight. The northerly and north-easterly winds which largely predominated after the first week of the month appear to have been associated with much cloud in those districts where they struck the coast at right angles. The most sunny place in the British Isles was Turnberry on the Ayrshire coast, with 5·2 hours of bright sunshine per day, whilst at Scarborough there were only 2·3 hours per day.

A Comparison of Rain Gauge Sites.

THE need for great care in the selection of rain gauge sites is well brought out in an investigation which is being carried out at the Royal Air Force Marine and Armament Experimental Station, Isle of Grain, Kent. Originally, the rain gauge was exposed on a bank or ridge, the height of which was 5 to 6 feet above the water-level on the east and 11 feet above the level ground on the west. The ridge runs north and south along the seashore, *i.e.*, on the east coast of the "island."

It was found that the rain measured at Grain was considerably lower than at neighbouring stations, and over-exposure was suspected. A new gauge was therefore installed at the beginning of the year, and measurements from the two gauges compared. The new gauge is 50 yards inland on nearly level ground; this ground, like the slope of the bank, being covered with coarse, long grass.

In January 1922, the new gauge gave 59.5 mm. against 45.6 mm., in the old, while the figures for February are 33.4 mm. in the new and 26.3 mm. in the old gauge. It is found that with light winds the agreement is good, but with stronger winds a marked discrepancy occurs, more especially with winds having an easterly component.

The hyetograph, which was originally exposed near the old gauge, was transferred to the new site at the end of February; in January, the hyetograph recorded 39.9 mm. as against the 45.6 mm. of the old gauge, while for the eight days in February, when it was in its new position, it gave 14.1 mm. as against 15.4 in the new gauge.

An unusual Cloud Structure.

THE unusual cirrus formation illustrated on the plate facing page 100, was observed by Mr. D. F. Bowering at Felixstowe, at 6h. 30m. G.M.T. on March 1st. No other cloud was visible except this wave-like structure consisting of cirro-stratus at the thicker parts and of cirrus at the ends; it was situated due south of the station at an angle of 45° from the horizon. A nephoscope observation gave the speed-height ratio as 8 radians per hour from south-west, so that on the assumption that the height of the cloud was 5 miles, the speed must have been about 40 miles an hour.

Both horizontally and vertically the details of this structure were clearly defined and detached and the waves were apparently equidistant from each other with the sky blue between. The outside sections were identical with each other both in structure and formation. Shortly afterwards the sky began rapidly to cloud over and at 7h. it was more than half covered with strato-cumulus; some cirro-stratus was also visible and was found to be moving at about 45 miles per hour from the west. Mr. G. A. Clarke of Aberdeen, who has seen Mr. Bowering's report, states that the phenomenon is rare and that the cloud type is more akin to cirro-cumulus than to true cirrus. He himself observed a very similar case on December 8th, 1911, at 10h. when the waved bands were very extensive, the lowest was continuous, the middle one partially so and the uppermost broken. The direction of the cirrus cloud was west by south and the lie of the band corresponded fairly well with the direction of the wind which sprung up later in the day, reaching force 7 at 23h. The cloud band faded away in a few moments and at 10h. 5m. only a few broken lines showed. Mr. Clarke points out that the spaces between the sets of cloudlets in Mr. Bowering's example would just hold another wave so that they may have been parts of a continuous waved band. It is a coincidence that in each case the band was triple.

The Travels of a Balloon.

DURING a "Shopping Carnival" week in December, 1921, at Thrapston, Northamptonshire, rubber balloons were released for advertising purposes. On the 12th to 14th of December balloons filled with pure hydrogen were used, and on December 20th one of these was picked up in a field near Cremona in Italy, at a distance of approximately 800 miles from Thrapston. Unfortunately it is not known on what date the balloon fell.

From the 12th to 16th of December, southern England and France were situated between two anticyclones. One extended from the Bay of Biscay to the Azores; the other was established over Poland and south-eastern Europe. France and England were more under the influence of the former than of the latter.

During this period pilot balloon ascents over England and France show winds mainly from between north and north-west. On the evening of the 12th, at Cranwell in Lincolnshire, a wind of 17 miles per hour from north-west at an elevation of 7,000 feet was recorded; at the same time Calshot recorded a wind of 18 miles per hour from the same direction at 6,000 feet.

On the 13th at Pulham there was a wind of 13 miles per hour from north by west at 6,000 feet and at Lympne, a wind of 5 miles per hour from west by north at 4,000 feet. On the 14th, Rennes in north-west France had a wind of 22 miles per hour from north-north-west at 5,000 feet and on the morning of the 17th, Friedrichshafen had a wind of 23 miles per hour from west by north at 9,000 feet. It will be seen that the evidence is consistent with the travel of a balloon from Thrapston to Italy. There are no other pilot balloon ascents which add to our information of the upper currents during the period of the balloon's journey, but the nephoscope observations at Valencia and Eskdalemuir between the 12th and the 15th of December show a strong northerly wind near the cirrus level.

The interest shown in this incident suggests that it would be desirable to have labels on all pilot balloons, to be detached and returned by post to the meteorological stations. At present only the places at which *ballons sondes* are recovered are reported.

Underground Water Level.

To judge by the present condition of the chalk wells at Detling to the north of Maidstone, it is practically certain that there will be hardly any yield of water during the coming summer. Regular observations, covering a period of nearly 40 years, of the water level in a well at the Croft, Detling, show that the saturation level is usually highest between mid-March and mid-April, and is succeeded by a gradual decline to the lowest position in November or December. On March 1st of this year the saturation level was only 3 inches above the well bottom (the well is 112 feet in depth, in chalk throughout) and the well became entirely dry on March 21st, a condition of affairs which is still maintained, though it has never before occurred, at this season, during the past 70 years. It is on record that the supply failed in 1858, and again in 1902; the well was dry throughout December of the latter year, a rise set in, however, during the first week of 1903, and by mid-April the saturation level was

10 feet above the well bottom. In another well, half a mile south-west of the Croft, dug in the chalk and just reaching the gault at a depth of 63 feet, the yield failed on October 3rd, 1921, the well continuing dry to March 20th, 1922. On March 27th 2 inches of water were recorded, 18 inches on April 3rd, 24 inches on April 10th, and 25 inches on April 17th. On April 24th the water had fallen to 15 inches, showing a definite decline in the saturation level of 10 inches. SPENCER RUSSELL.

Records at Falmouth for 1921.

Meteorological Notes and Tables for the Year 1921 has been received from Falmouth Observatory. The pamphlet, which has been prepared by Messrs. W. L. Fox and J. B. Phillips, is published by the Royal Cornwall Polytechnic Society. During 1921, at Falmouth, pressure, sunshine and temperature were above the average, rainfall was considerably below the average and there was a marked frequency of northerly winds.

The maximum temperature, 82·8° F. on July 18th is the highest ever recorded at Flamouth, a temperature of over 80° F. having been reached only four times since 1885.

A New Laboratory for Work on Atmospheric Pollution.

THROUGH the kindness of Professor H. B. Baker, F.R.S., a room in the Imperial College of Science and Technology has been placed temporarily at the disposal of the Meteorological Office. The Office has fitted up the room as a laboratory for the use of the Advisory Committee on Atmospheric Pollution. There is an ante-room which may be used as a photographic dark-room, while the room itself is well equipped with apparatus, including facilities for glass-blowing. This new laboratory will be of great assistance in the work on atmospheric pollution.

British Association Meeting, 1922.

THE meeting of the British Association will take place this year at Hull, September 6th to 13th. Mr. M. A. Giblett (Meteorological Office, Air Ministry, Kingsway, W.C.2) will again represent Meteorology on the Committee of Section A (Mathematics and Physics), as a Secretary of that Section.

Obituary.

Henry Newton Dickson.—Dr. H. N. Dickson, whose death occurred on April 2nd, was born at Edinburgh in 1866. He studied at the University of Edinburgh and gained much practical experience in physiography by voluntary work in connection with the *Challenger* expedition, the Scottish Marine Station, and the Ben Nevis Observatory. In 1891 he investigated the salinity and temperature of the English Channel for the Marine Biological Association at Plymouth, and in 1893 he joined the lecturing staff at Oxford. While there he continued the work which he had started at Plymouth, extending his researches to cover the North Atlantic. In 1901, with the co-operation of the Meteorological Office, Dickson produced his most important work, *The circulation of the Surface Waters of the North Atlantic Ocean.** From 1906–1920 he was professor of geography at University College, Reading, and during the war he placed his wide experience at the service of the Intelligence Department of the Admiralty, where he prepared an important series of handbooks descriptive of those regions in which military operations were either occurring or likely to occur. His last work was in the Editorial Department of the *Encyclopædia Brittanica*, on the additional volumes for the 12th edition.

Dickson published two useful text-books, *Elementary Meteorology*, which appeared in 1893, and *Climate and Weather*, 1912. He also devoted much time to the study of the underground water in the chalk formations near London and an important investigation of evaporation from an exposed surface, for which he had devised an automatic recording evaporimeter, was interrupted by the outbreak of war.

During 1911 and 1912 Dickson was President of the Royal Meteorological Society. It had been evident for some time that the development of the Meteorological Office and its *Monthly Weather Report* had rendered necessary a reconsideration of the work of the Society, which had been a pioneer in the collection of climatological observation from its Fellows. Dickson recognized the need for ending the duplication of work and publication, and devoted himself to the arrangements by which the responsibility for the collection, reduction and publication of the climatological records was transferred to the Meteorological Office. To effect a break of this kind and, at the same time, to prevent a weakening of the Society and its activities required great tact and judgment. But the Society was numerically as strong afterwards as before and the improvement in the quality of the *Quarterly Journal* which followed the change was patent to all.

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* *Roy. Soc. Phil. Trans.* A. 196, 1901.

Dickson had a great fund of humour and it was always a pleasure to get a seat next to him at the dinners of the Meteorological Club at the old Westminster Palace Hotel. He had, moreover, an enthusiasm for meteorology and had begun to get students at Reading to do research work in the subject, when the war came and closed, for the time, that field of enterprise. E. G.

News in Brief.

The Council of the Royal Astronomical Society has decided to issue special supplements to the *Monthly Notices*, containing papers of geophysical interest which have been submitted to the Society and which may or may not have been previously read at the Discussions. The Discussions will continue to be published in the *Observatory*. Non-members of the Society who wish to receive these supplements are invited to apply as soon as possible to the Assistant Secretary, Royal Astronomical Society, Burlington House, London, W.1, stating whether they desire a regular supply or not. The price will depend on the number and length of the papers printed, but will not for the present exceed 10s. per annum.

On April 7th, two aeroplanes on the London-Paris Service collided in the fog near Beauvais. Seven lives were lost, including those of the two pilots, Mr. R. E. Duke and M. Jean Mire. Owing to the fog, the machines were flying at less than 600 feet. This accident has caused considerable discussion of methods for guiding pilots in bad weather, and on April 14th, a conference of British and French pilots and airway managers was held at Croydon. It is gratifying to learn that from 1919 to September 1921, over 142,000 passengers were carried and only 12 have been killed.

News is received that the two Portuguese aviators, G. Coutinho and T. S. Cabral, who were attempting the 4,000 mile flight from Lisbon to Rio de Janeiro, encountered heavy weather and were forced on April 19th to land on the St. Paul's Rocks, about 550 miles from the Brazilian coast, with the result that the seaplane was too severely damaged to continue the journey. The Portuguese Government have sent out another seaplane and it is hoped that the flight may be resumed.

Sir Ross Smith, who flew from England to Australia, was to have attempted the flight around the world but, while testing the machine for this purpose at Brooklands on April 13th, he and his engineer, Lieut. J. N. Bennet, were killed. The death of this distinguished aviator is greatly to be deplored.

The death is announced at the age of 81 of Mr. Adolphus Collenette, Director of the States Meteorological Service, Guernsey. We hope later to publish an obituary notice.

Dr. G. C. Simpson has been elected a member of the Athenæum Club under the provisions of a rule of that club which empowers the annual election by the committee of a certain number of persons of distinguished eminence in science, literature or the arts, or for public service.

The following note appears in a return of observations from Kilkenny :—" Owing to the Castle being occupied by armed forces and the instruments in the line of fire, it was impossible to take readings for the two days, May 3rd and 4th."

During the partial eclipse of the sun on March 28th, 1922, temperature in the shade at Malta dropped from 62° F. to 55° F.

The Weather of April, 1922.

In north-western Europe, April was for the most part a cold, unsettled month. At the beginning of the month, the chief feature of the pressure distribution was the existence of two large areas of high pressure, one between Iceland and Spitzbergen, the other over Madeira and southern Spain. These two highs persisted with little change for the first fortnight. Between these anticyclones a series of depressions moved in from the Atlantic, crossing the British Isles or their vicinity, and causing the prevalence of very unsettled conditions over northwest Europe.

During the first eight days of April, stations in the Azores reported some heavy falls of rain. On the 1st, Ponta Delgada recorded 72 mm., and Horta 26 mm., while on the 8th, Horta had 50 mm.

On the 3rd of the month, a deep depression moved up the Channel causing easterly gales in the Channel accompanied by heavy precipitation and low temperatures on the northern side of its track, particularly in southern England and the midlands. Continuous rain, sleet or snow fell in most localities. Kew reported a rainfall of 14 mm., and Croydon 18 mm. in the 24 hours, while on the Continent, the Helder and Flushing each had 73 mm. The maximum temperature for the day was only 33° F. at Malvern, 34° F. at Ross-on-Wye and 35° F. at Hampstead. By the 4th, this depression was over Germany, causing rain or snow there and in southern Scandinavia. Unsettled weather was maintained over the British Isles until the 14th. The warmest weather of the month was experienced in the south of England on that day, and was due to a supply of warm air on the southern side of a depression centred to the south of Ireland. The temperature at Kew Observatory on that day reached 67° F

This depression, which deepened as it passed to the north of Ireland and thence to the North Sea, caused strong winds and gales, with heavy rain in places, over the British Isles and on the southern coasts of Norway. The full force of the gale was felt in the English Channel,where considerable structural damage was done in places and shipping held up. On the 15th the warm air had reached Germany, where Berlin had a maximum of 81° F.

In the rear of the depression the northerly wind current caused a marked drop of temperature over the British Isles, the maximum temperature at Kew on the 16th being only 50° F.

The squally northerly winds persisted over western Europe for a day or two with rain and hail showers over a wide area, and on the 17th temperatures failed to exceed 45° F. at many places in Denmark, Scotland, and parts of France, but reached 70° F. at Vienna, 75° F. at Warsaw and 77° F. at Posen.

The northerly current decreased and an anticyclone spread in from the west, and by the 18th extended from the Azores to Scandinavia. This high-pressure system continued in the form of a ridge from the Azores to Scandinavia for three or four days, although decreasing in intensity, and gave generally fair weather in the British Isles and western Europe, with sharp night frosts in many localities. On the 20th, Renfrew recorded a maximum of 61° F. and Eskdalemuir one of 60° F.

By the 22nd, a shallow depression had formed over south-east England causing a break up of the fine weather.

On the 23rd a depression over Iceland deepened and moved in a south-easterly direction, and by the evening of the 24th it was over the North Sea causing rain in most districts of western Europe.

This was followed by another depression moving in from the Atlantic, and on the 25th and 26th a large low-pressure system, within which were several well-marked centres, covered the area around the British Isles.

Considerable variations of temperature were associated with this distribution of pressure. For example, on the 18h. chart of the 25th the temperature at St. Ann's Head, in the warm sector of one of the depressions, was 48° F. whilst at Holyhead, in the cold sector, the temperature was only 41° F. Next morning much snow was lying on the hills of Shropshire and Central Wales though there was only a sprinkling on the top of the Black Mountains in Breconshire.

On the morning of the 26th, the centre of the low area was over the southern North Sea, whence it moved to Denmark and then to Scandinavia. The northerly winds in its rear continued until the end of the month accompanied by occasional hail or rain showers and local thunder.

A depression centred over the Gulf of Lyons on the 28th moved north-eastwards, and by the morning of May 1st it was over Scandinavia. In its passage it caused heavy rain in parts of France, Switzerland, Germany and Denmark. On the 30th, temperature rose to 72° F. at Vienna and to 70° F. at Prague.

In southern Europe the weather for the whole of the month was fine with very little rainfall, conditions which also prevailed in the eastern Mediterranean. Temperatures exceeding 100° F. were twice recorded at Cairo during the month, 104° F. on the 16th, and 102° F. on the 21st.

W. C. K.

Heavy rains in Switzerland at the beginning of the month caused a serious landslide near Le Bouveret (Valais) in the Rhône Valley. The village of Les Evouettes was partially buried. Floods were subsequently reported from all parts of the country and also in the Rhône Valley in France. At Lyons the lower part of the town was under water. There was a considerable amount of minor damage by avalanche and landslide owing to the continued rainfall.

At the end of the month the Seine was high. Floods were feared in the Toulouse neighbourhood where torrential rain fell throughout the 29th.

(*Continued on* p. 116.)

Rainfall Table for April 1922.

STATION.	COUNTY.	Aver. 1881—1915.	1922.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	1·54	3·02	77	196	·53	3	17
Tenterden (View Tower)	*Kent*	1·62	3·10	79	191	·53	12	18
Arundel (Patching Farm)	*Sussex*	1·75	3·73	95	213	·92	3	16
Fordingbridge (Oaklands)	*Hampshire*	1·83	3·30	84	180	·76	13	18
Oxford (Magdalen College)	*Oxfordshire*	1·54	2·61	66	169	·48	13	19
Wellingborough (Swanspool)	*Northampton*	1·49	3·19	81	214	·49	25	18
Hawkedon Rectory	*Suffolk*	1·54	2·84	72	184	·63	25	18
Norwich (Eaton)	*Norfolk*	1·71	2·49	63	146	·52	25	15
Launceston (Polapit Tamar)	*Devon*	2·34	4·83	123	207	·65	15	20
Sidmouth (Sidmount)	,,	2·13	2·91	74	137	·69	13	20
Ross (County Observatory)	*Herefordshire*	1·89	2·68	68	142	·63	3	19
Church Stretton (Wolstaston)	*Shropshire*	2·16	3·15	80	146	·71	25	18
Boston (Black Sluice)	*Lincoln*	1·35	2·28	58	169	·55	5	17
Worksop (Hodsock Priory)	*Nottingham*	1·47	2·86	73	195	·46	25	20
Mickleover (Clyd House)	*Derbyshire*	1·73	2·83	72	164	·49	25	19
Southport (Hesketh Park)	*Lancashire*	1·85	1·54	39	83	·30	12	17
Harrogate (Harlow Moor Ob.)	*York, W. R.*	1·84	3·15	80	171	·45	12	17
Hull (Pearson Park)	*,, E. R.*	1·56	1·55	39	99	·24	15,23	18
Newcastle (Town Moor)	*North'land*	1·64	2·02	51	123	·51	14	17
Borrowdale (Seathwaite)	*Cumberland*	7·42	3·85	98	52	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	2·53	3·47	88	137	·62	25	23
Haverfordwest (Gram. Sch.)	*Pembroke*	2·62	4·42	112	169	1·07	1	18
Aberystwyth (Gogerddan)	*Cardigan*	2·61	2·53	64	97	·72	25	5
Llandudno	*Carnarvon*	1·81	2·24	57	124	·59	12	17
Dumfries (Cargen)	*Kirkcudbrt.*	2·67	2·63	67	98	1·23	14	13
Marchmont House	*Berwick*	2·02	2·32	59	115	·82	14	12
Girvan (Pinmore)	*Ayr*	2·97	3·48	88	117	1·36	14	19
Glasgow (Queen's Park)	*Renfrew*	1·97	1·70	43	86	·85	14	13
Islay (Eallabus)	*Argyll*	2·87	3·10	79	108	·95	14	16
Mull (Quinish)	,,	3·30	3·41	87	10	·81	14	19
Loch Dhu	*Perth*	4·74	6·00	152	127	2·80	14	9
Dundee (Eastern Necropolis)	*Forfar*	1·70	1·55	39	91	·82	14	15
Braemar (Bank)	*Aberdeen*	2·37	4·09	104	173	·78	15	20
Aberdeen (Cranford)	,,	2·05	3·70	94	180	·87	14	20
Gordon Castle	*Moray*	1·75	4·07	103	232	1·02	15	22
Fort William (Atholl Bank)	*Inverness*	4·47	2·54	65	57	·55	14	16
Alness (Ardross Castle)	*Ross*	2·42	4·01	102	166	1·23	15	19
Loch Torridon (Bendamph)	,,	5·22	5·74	146	110	·89	15	19
Stornoway	,,	3·03	2·56	65	84	·38	14	22
Loch More (Achfary)	*Sutherland*	4·85	6·08	154	125	1·04	15	22
Wick	*Caithness*	1·99	3·41	87	171	·90	15	20
Glanmire (Lota Lodge)	*Cork*	2·80	3·52	89	126	1·17	14	18
Killarney (District Asylum)	*Kerry*	3·31	3·31	84	100	·80	14	22
Waterford (Brook Lodge)	*Waterford*	2·54	2·71	69	107	·95	14	15
Nenagh (Castle Lough)	*Tipperary*	2·51	3·14	80	125	1·35	14	21
Ennistymon House	*Clare*	2·75	..	..	..	..	..	..
Gorey (Courtown House)	*Wexford*	2·19	3·29	84	150	1·20	14	16
Abbey Leix (Blandsfort)	*Queen's Co.*	2·61	3·65	93	140	1·05	14	19
Dublin (FitzWilliam Square)	*Dublin*	1·90	2·28	58	120	·56	14	20
Mullingar (Belvedere)	*Westmeath*	2·37	2·85	72	120	1·01	14	13
Crossmolina (Enniscoe)	*Mayo*	3·14	..	..	..	..	..	..
Collooney (Markree Obsy.)	*Sligo*	2·66	4·29	109	161	1·18	14	22
Seaforde	*Down*	2·62	4·68	119	179	1·57	14	15
Ballymena (Harryville)	*Antrim*	2·64	4·00	102	151	1·00	15	18
Omagh (Edenfel)	*Tyrone*	2·63	3·71	94	141	·87	14	16
Letterkenny Asylum	*Donegal*	2·80	4·24	108	151	1·38	14	19

Supplementary Rainfall, April 1922.

Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	1·73	44
"	Sevenoaks, Speldhurst	3·40	86
"	Hailsham Vicarage	3·21	81
"	Totland Bay, Aston Ho.	2·88	73
"	Ashley, Old Manor Ho.	4·21	107
"	Grayshott	4·46	113
"	Ufton Nervet	3·23	82
III.	Harrow Weald, Hill Ho.	2·95	75
"	Pitsford, Sedgebrook	3·05	77
"	Chatteris, The Priory	2·67	68
IV.	Elsenham, Gaunts End	2·72	69
"	Lexden, Hill House	2·42	61
"	Aylsham, Rippon Hall	3·53	90
"	Swaffham	1·98	50
V.	Devizes, Highclere	3·46	88
"	Weymouth	3·01	76
"	Ashburton, Druid Ho.	5·93	151
"	Cullompton	3·28	83
"	Hartland Abbey	3·73	95
"	Penzance, Morrab Gden.	3·45	88
"	St. Austell, Trevarna	4·57	116
"	Crewkerne Merefield Ho	3·54	90
VI.	Clifton College	2·62	67
"	Ledbury, Underdown	2·63	67
"	Shifnal, Hatton Grange	2·16	55
"	Ashbourne, Mayfield	2·51	64
"	Barnt Green, Upwood	3·07	78
"	Blockley, Upton Wold	3·67	93
VII.	Leicester, Town Hall Sq.	2·64	67
"	Grantham, Saltersford	2·94	75
"	Louth, Westgate	1·96	50
"	Mansfield, West Bank	3·38	86
VIII.	Nantwich, Dorfold Hall	2·42	61
"	Bolton, Queen's Park	2·49	63
"	Lancaster, Strathspey	1·91	49
IX.	Wath-upon-Dearne	2·92	74
"	Bradford, Lister Park	3·48	88
"	West Witton	3·15	80
"	Scarborough, Scalby	1·83	47
"	Middlesbro', Albert Pk.	1·33	34
"	Mickleton	3·40	86
X.	Bellingham	2·06	52
"	Ilderton, Lilburn	2·10	53
"	Orton	2·88	73
XI.	Llanfrechfa Grange	..	..
"	Treherbert, Tyn-y-waun	5·75	146
"	Carmarthen Friary	3·00	76
"	Lampeter, Falcondale	4·19	106
"	Cray Station	5·00	127
"	B'ham W.W., Tyrmyndd	4·55	116
"	Lake Vyrnwy	3·47	88
"	Llangynhafal, P. Drâw	2·82	72
"	Oakley Quarries	4·38	111
"	Dolgelly, Bryntirion	3·33	85
"	Snowdon, L. Llydaw	8·97	228
"	Lligwy	2·16	55
XII.	Stoneykirk, Ardwell Ho.	2·81	71
"	Carsphairn, Shiel	5·29	134
XII.	Langholm, Drove Rd.	2·21	56
XIII.	Ettrick Manse	4·24	107
"	North Berwick Res.	1·93	49
"	Edinburgh, Royal Ob.	1·51	39
XIV.	Biggar	2·09	53
"	Leadhills	4·68	119
"	Kilmarnock, Agric. Coll.	2·19	55
XV.	Dougarie Lodge	3·90	99
"	Oban	3·13	79
"	Holy Loch, Ardnadam	..	..
"	Tiree Cornaigmore	..	..
XVI.	Loch Venachar	3·35	85
"	Glenquey Reservoir	2·50	63
"	Loch Rannoch, Dall	2·09	53
"	Blair Atholl	2·25	57
"	Coupar Angus	1·48	38
"	Montrose Asylum	2·37	60
XVII.	Logie Coldstone, School	3·56	90
"	Fyvie Castle	3·73	95
"	Grantown-on-Spey	5·04	128
XVIII.	Kingussie, Fasnakyle	2·70	69
"	Fort Augustus	1·94	49
"	Loch Quoich, Loan	7·80	198
"	Fortrose	1·39	35
"	Faire-na-Squir	..	..
"	Skye, Dunvegan	4·24	108
XIX.	Loch Carron, Plockton	2·66	68
"	Dornoch, St. Gilbert's	2·19	56
"	Tongue Manse	4·41	112
"	Melvich Schoolhouse	3·77	96
XX.	Dunmanway Rectory	3·74	95
"	Mitchelstown Castle	3·33	85
"	Gearahameen	6·20	157
"	Darrynane Abbey	4·04	103
"	Cashel, Ballinamona	2·41	61
"	Roscrea, Timoney Pk.	2·82	72
"	Ballybunion	2·24	57
"	Broadford, Hurdlesto'n	2·85	72
XXI.	Kilkenny Castle	2·14	54
"	Rathnew, Clonmannon	2·89	73
"	Hacketstown Rectory	3·23	82
"	Balbriggan, Ardgillan	2·69	68
"	Drogheda	2·65	67
"	Athlone, Twyford	2·84	72
XXII.	Castle Forbes Gdns.	2·43	62
"	Ballynahinch Castle	4·82	122
"	Galway Grammar Sch.	3·28	83
XXIII.	Westport House	3·56	90
"	Enniskillen, Portora	2·81	71
"	Armagh Observatory	3·09	78
"	Warrenpoint	3·16	80
"	Belfast, Cave Hill Rd.	3·73	95
"	Glenarm Castle	5·19	132
"	Londonderry, Creggan	3·80	97
"	Sion Mills	3·49	89
"	Milford, The Manse	3·88	99
"	Narin, Kiltoorish	3·13	79
"	Killybegs, Rockmount	3·56	90

Correction—Gearahameen for February, "15·00/381."

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L. mb.	Diff. from Normal mb.	Max. ° F.	Date	Min. ° F.	Date	Max. ° F.	Min. ° F.	½ max. and min. ° F.	Diff. from Normal ° F.
London, Kew Observatory	1018·8	+4·6	58	1	23	11	45·5	35·5	40·5	−3·5
Gibraltar	1016·8	+0·3	75	4	48	28, 29	67·0	55·9	61·5	+1·2
Malta	1015·2	−0·5	74	5	47	10	65·6	59·1	62·3	−0·8
Sierra Leone	1011·9	+0·8	92	7	70	30	87·1	73·8	80·5	−0·7
Lagos, Nigeria	1012·5	+1·7	89	1, 9	73	4	87·0	76·1	81·5	+0·2
Kaduna, Nigeria	..	..	..	..	..	..	..	..	..	..
Zomba, Nyasaland	1009·9	+0·9	97	12	56	3	83·1	65·3	74·2	−0·9
Salisbury, Rhodesia	1010·1	+0·1	99	10	49	1	84·7	55·7	70·2	−0·7
Cape Town	1016·1	+0·4	89	25	49	12	75·6	57·4	66·5	+3·4
Johannesburg	1013·1	+0·3	82	10	36	13	70·8	51·9	61·3	−2·1
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	..	..	89	18	39	13	79·4	53·5	66·5	−1·9
Calcutta, Alipore Obsy.	1014·6	+1·3	86	8	58	19	82·6	63·0	72·8	−0·3
Bombay	1013·1	+1·2	91	1	71	29	87·5	73·1	80·3	0·0
Madras	1013·6	+1·9	87	18	63	10	85·1	69·8	77·5	−1·2
Colombo, Ceylon	1012·1	+2·0	91	14	70	15	88·2	73·1	80·7	+0·4
Hong Kong	1017·6	0·0	82	21	59	27	75·5	65·6	70·5	+0·8
Sandakan	..	..	91	13	74	sev.	87·7	75·4	81·5	+0·5
Sydney	1013·4	−0·3	90	5	53	8	76·8	61·7	69·3	+2·3
Melbourne	1012·7	−1·4	100	18	47	22	73·0	54·5	63·7	+2·4
Adelaide	1013·8	−1·3	108	18	46	21	80·0	57·4	68·7	+1·8
Perth, Western Australia	1015·2	−0·1	86	7	50	5, 19	73·9	55·5	64·7	−1·0
Coolgardie	1012·7	−0·4	98	29	45	19	83·4	54·5	68·9	−1·9
Brisbane	1014·5	+0·2	91	30	61	1	83·4	65·9	74·7	+1·2
Hobart, Tasmania	1008·3	−1·0	96	17	43	20	70·1	51·3	60·7	+3·5
Wellington, N.Z.	1011·2	−0·4	71	8	38	2	61·8	49·2	55·5	−1·4
Suva, Fiji	1011·8	+0·7	87	26	61	13	83·9	67·9	75·9	−1·3
Kingston, Jamaica	1013·9	+1·2	90	9	67	17	87·6	70·7	79·1	−0·2
Grenada, W.I.	1012·3	+1·7	89	11, 12, 16	73	6, 16, 23	85·4	75·0	80·2	+0·9
Toronto	1018·0	+1·2	62	19	21	23	42·0	30·7	36·3	0·0
Winnipeg	1019·9	+3·2	46	3	14	19, 21, 22	24·5	12·0	18·3	−2·5
St. John, N.B.	1016·6	+2·7	54	1	11	27	37·2	26·5	31·9	−4·8
Victoria, B.C.	1015·1	−0·4	58	4	24	21	47·3	40·2	43·7	−0·7

London, Kew Observatory.—Mean speed of wind 6·1 mi/hr ; 1 day with snow, 16 days with fog. † Wet Bulb Thermometer broken.

Gibraltar.—2 days with fog, 2 days with gale.

Malta.—Wind direction variable. 2 days with hail, 3 days with thunder heard, 1 day with fog.

Sierra Leone.—Calms predominate. 7 days with thunder heard, 2 days with gale.

Madras.—1 day with thunder heard.

MELBOURNE :—	September 1921	1016·4	+0·6	75	6	38	4	65·3	46·3	55·8	+1·8
LAGOS corrected values	Feb. 1921	..	..	..	..	..	..	88·2	..	82·7	+0·6
	March 1921	1009·8	+0·4	..	..	..	..	89·4	..	83·5	+0·6
	April 1921	..	..	..	..	..	..	91·3	..	84·1	+1·8

British Empire, November 1921.

TEMPERATURE Mean Wet Bulb ° F.	TEMPERATURE Absolute Min. on Grass ° F.	Relative Humidity %	Mean Cloud Am'nt 0–10	PRECIPITATION Amount in.	PRECIPITATION Amount mm.	PRECIPITATION Diff. from Normal mm.	PRECIPITATION Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible	STATIONS
..†	16	..†	7·1	1·70	43	− 13	8	1·2	14	London, Kew Observatory.
58·1	41	84	4·3	5·25	133	− 28	9	..	..	Gibraltar.
57·7	39	79	5·6	3·87	98	+ 17	14	5·3	52	Malta.
76·1	..	78	5·5	9·35	237	+102	15	..	..	Sierra Leone.
76·5	71	83	8·9	3·35	85	+ 19	11	..	..	Lagos, Nigeria.
..	..	..	..	..	..	..	..	..	..	Kaduna, Nigeria.
..	..	74	4·9	3·41	87	− 55	8	..	..	Zomba, Nyasaland.
61·9	..	56	..	2·73	69	− 23	9	..	..	Salisbury, Rhodesia.
61·6	..	60	4·1	0·51	13	− 14	2	..	..	Cape Town.
54·1	35	66	5·9	3·57	91	− 17	15	7·4	56	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
56·6	..	54	5·1	1·36	35	− 23	14	..	..	Bloemfontein.
67·2	50	50	1·2	0·00	0	− 14	0*	..	..	Calcutta, Alipore Obsy.
71·4	59	62	1·4	0·00	0	− 10	0*	..	..	Bombay.
..	..	79	4·0	1·77	45	−280	2*	..	..	Madras.
75·8	64	65	5·3	3·46	88	−219	14	..	..	Colombo, Ceylon.
60·9	..	58	6·1	0·22	6	− 30	6	6·1	55	Hong Kong.
..	..	..	..	8·60	218	−155	13	..	..	Sandakan.
64·5	44	69	5·6	3·02	77	+ 3	12	6·4	46	Sydney.
58·6	40	62	6·1	2·61	66	+ 8	6	..	..	Melbourne.
57·6	37	45	5·2	2·20	56	+ 26	8	8·4	60	Adelaide.
58·9	41	61	4·6	0·84	21	+ 1	10	9·4	69	Perth, Western Australia.
57·8	..	35	3·7	0·20	5	− 12	1	..	..	Coolgardie.
69·1	55	69	3·8	3·24	82	− 13	9	..	..	Brisbane.
53·0	34	57	6·0	0·33	8	− 57	9	8·3	57	Hobart, Tasmania.
51·3	27	74	7·4	3·55	90	− 2	14	6·4	45	Wellington, N.Z.
73·8	..	86	..	20·27	515	+273	14	..	..	Suva, Fiji.
..	..	75	5·1	0·14	4	− 76	6	..	..	Kingston, Jamaica.
75·2	..	75	3·3	4·72	120	− 88	23	..	..	Grenada, W.I.
33·3	19	82	7·2	1·45	37	− 38	17	..	..	Toronto.
16·7	..	81	7·4	0·86	22	− 2	15	..	..	Winnipeg.
29·9	11	80	8·0	6·79	172	+ 60	9	..	..	St. John, N.B.
41·6	23	90	8·2	6·09	155	− 9	22	..	..	Victoria, B.C.

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

COLOMBO, CEYLON.—Prevailing wind direction N, mean speed 4·8 mi/hr. 4 days with thunder heard.

HONG KONG.—Prevailing wind direction ENE, mean speed 12·5 mi/hr.

HOBART, TASMANIA.—Mean temperature highest since 1872 (63·1).

WELLINGTON, N.Z.—1 day with hail.

SUVA, FIJI.—1 day with thunder heard.

GRENADA, W.I.—Prevailing wind direction E.

52·1	32	68	5·6	3·63	92	+ 31	14	..	..	MELBOURNE :— September 1921
..	..	..		..	..	..	..	..	..	Feb. 1921 LAGOS corrected values.
80·7	..	83		3·42	87	− 9	..	..	..	March 1921
..	..	..	..	..	..	..	..	..	..	April 1921

(*Continued from p.* 111.)

It was reported on the 6th that the ice in Reval Harbour (Esthonia) had broken up sufficiently to allow shipping movements without the assistance of an icebreaker. A telegram from Riga received in Paris on the 11th stated that a terrible catastrophe had occurred at Dvinsk through the breaking of the ice on the River Dvina. Great blocks of ice obstructed the river, which rose over 30 ft. and flooded the town, causing the death of about 1,000 persons The ice barrier was finally destroyed by gunfire. The usual date for the breaking of the ice is about March 29th. Navigation on the Volga was opened a few days before the end of the month.

A violent snowstorm was experienced at Hammerfest on the 11th.

About 55 mm. of rainfall fell in south-western Alberta during April. Navigation on the St. Lawrence was opened as far as Montreal on the 12th.

A series of tornadoes passed over various villages in Illinois, Indiana and Arkansas on the 17th; 20 persons were killed and large numbers injured. About a week previously a severe tornado swept over Texas and Oklahoma. The casualties on this occasion are believed to be numerous. Floods occurred with loss of life at Dallas (Texas). The Mississippi remained in a dangerously flooded state and Congress has voted $1,000,000 for the taking of immediate steps to control its waters.

A violent blizzard swept over the Mount Everest Expedition on the afternoon of the 8th, a few hours after it had left Phari Dzong, but there were no serious results of any kind.

The dry spell which has been causing anxiety to farmers in some parts of Australia was broken towards the end of April by rains in South Australia and New South Wales. Unusually high temperatures for the time of year were experienced during Easter at Sydney and Melbourne.

The special message from Brazil states that rainfall was excessive over the northern region, the excess being on the average 180 mm. above normal, but 300 to 600 mm. in certain stations. There were destructive floods in Amazonas, Ceara and Alagoas states. Rainfall was 20 mm. below normal in the centre and irregular in the south. The amount of sunshine was generally rather low but temperature was normal. The average pressure for April was 1·8 mb. above normal. Rice and cane plantations suffered from the floods. A severe storm occurred at Rio on the night of the 9th with high wind and much rain, which flooded portions of the town.

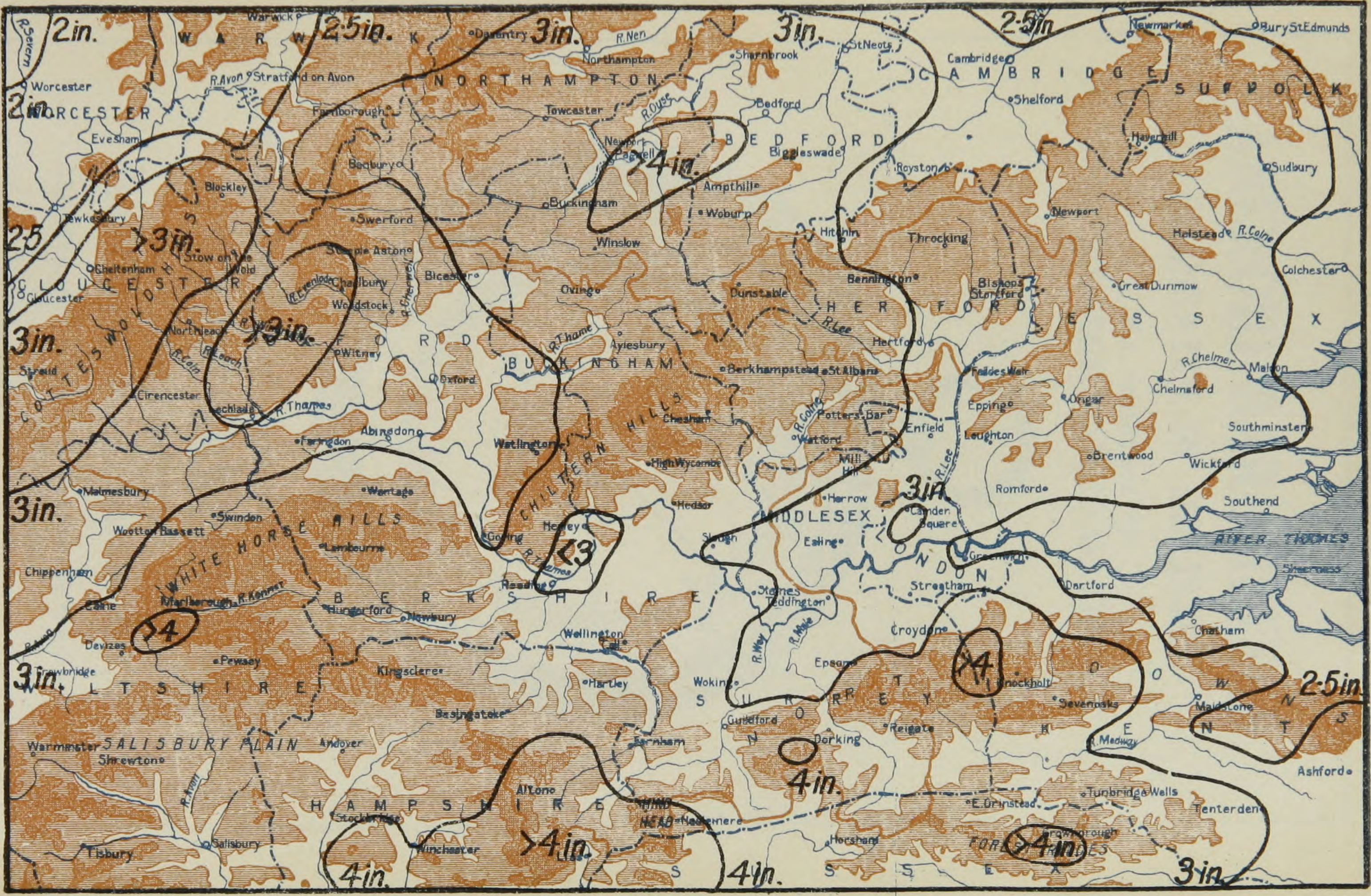
The rainfall of April was above the average for the period 1881–1915 nearly everywhere in the British Isles, the only exceptions being in the north-west of Great Britain. Isolated areas in Cornwall, Northamptonshire and in Morayshire recorded more than twice the average. The general distribution of rainfall was somewhat similar to that in April 1920. Falls of less than 50 mm. (2 in.) were confined mainly to the east coasts of England and Scotland between the Wash and Montrose, but a few stations in the Central Plain of Scotland also had less than this amount. Falls of more than 100 mm. (4 in.) were widespread, but the areas with more than 150 mm. (6 in.) were extremely restricted.

The total rainfall of the four months January to April in the south-east of England has been approximately 50 per cent. in excess of the average.

The general rainfall for April, expressed as a percentage of the average, was:—England and Wales, 155; Scotland, 126; Ireland, 136; British Isles, 141.

In London, Camden Square, the mean temperature for April was 44·1° F., or 3·9° F. below the average; the duration of rainfall, 75·2 hours; and the evaporation, 1·20 inch.

THAMES VALLEY RAINFALL ——APRIL, 1922.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3in.
>3in.
>4in.
>4
<3
4in.
2.5
ALTITUDE SCALE
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500 to 1000 feet
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5
10
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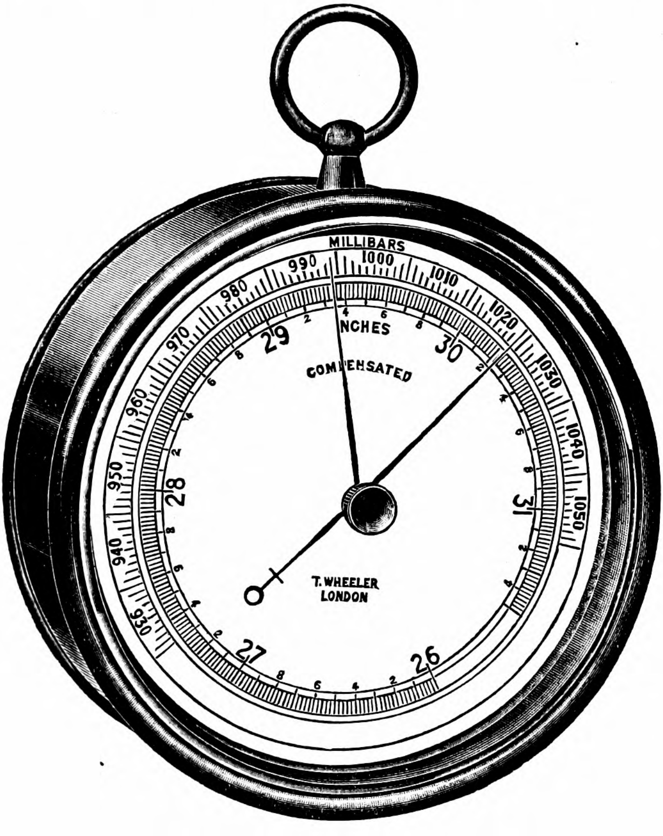

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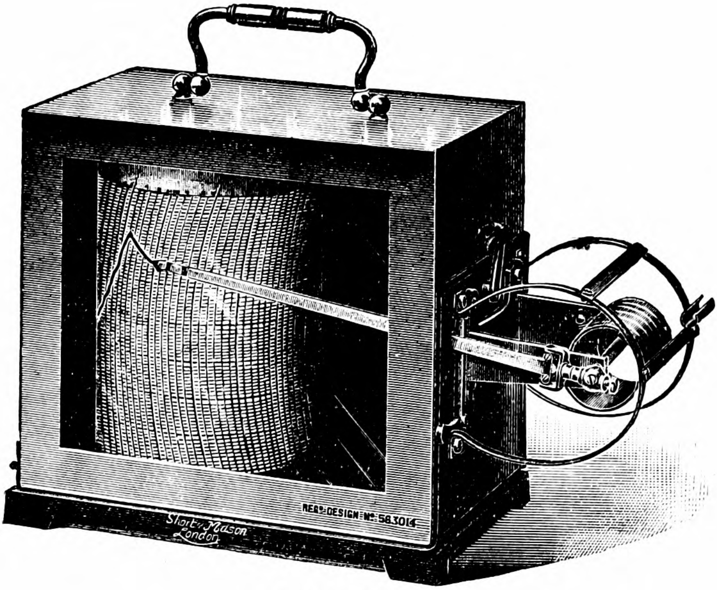

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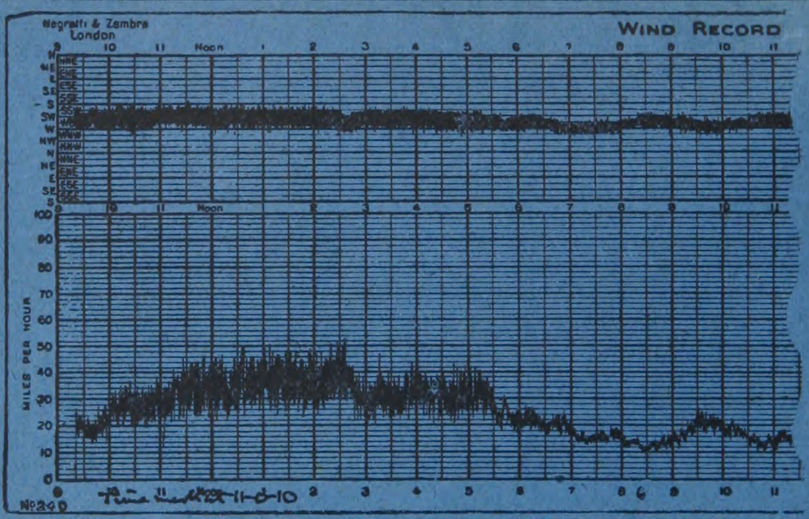

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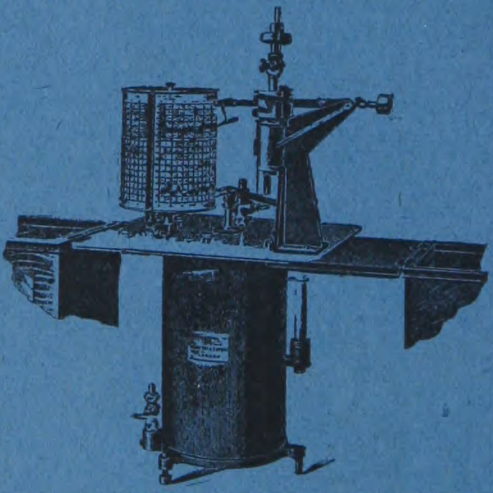

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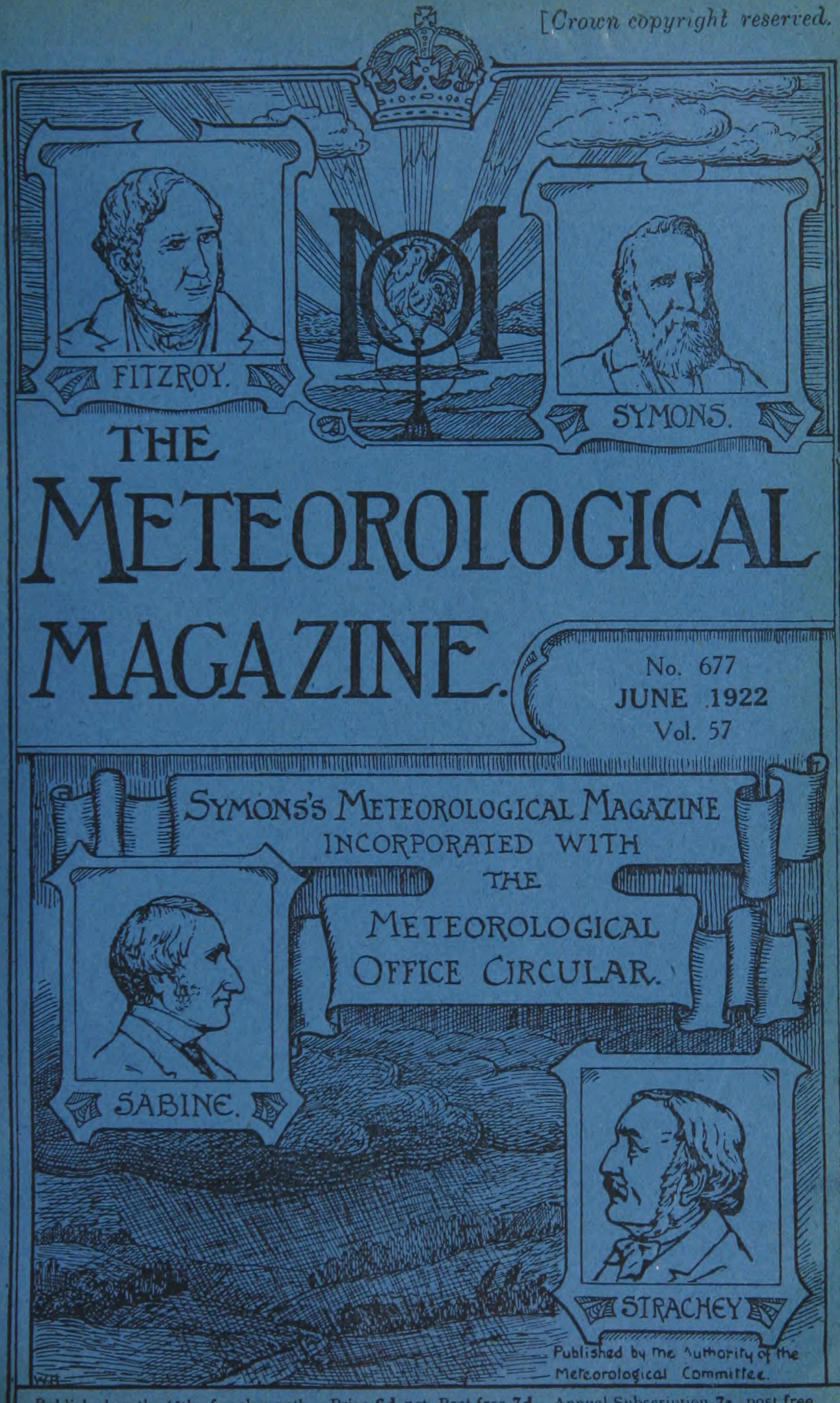

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JUNE 1922.

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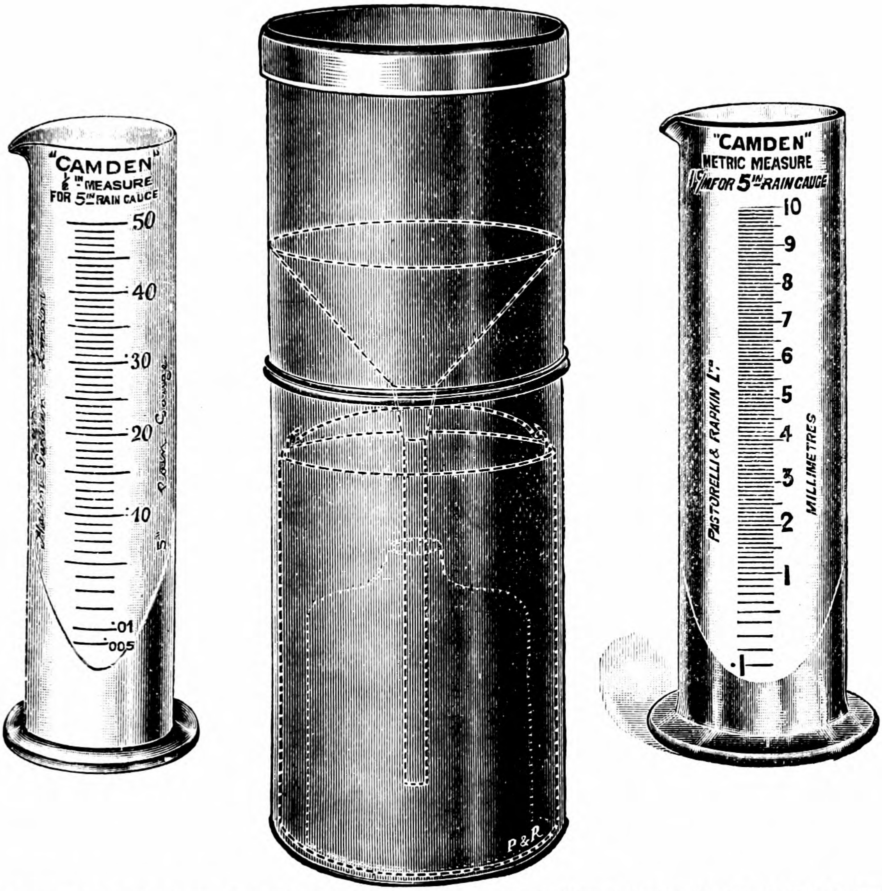
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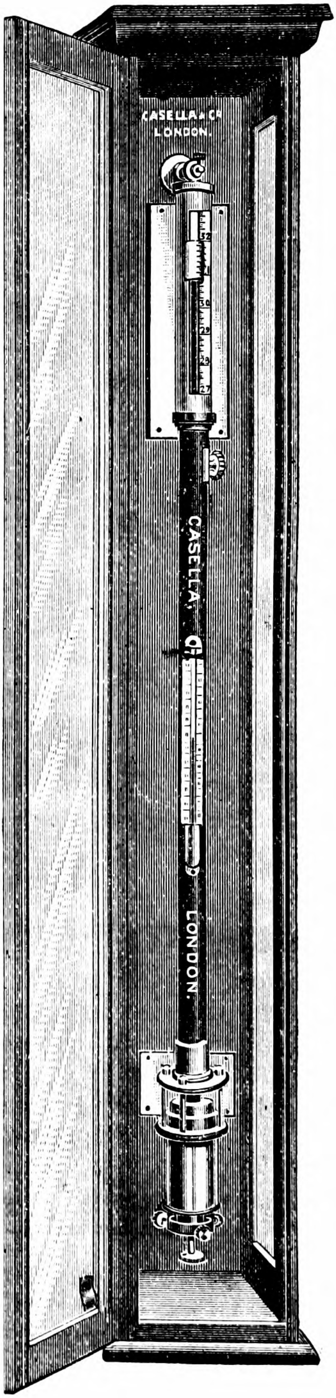
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The International Meteorological Committee.

THE Proceedings of the International Meteorological Committee which met in London last October are being published in a Report which is to be issued shortly. The Report is of necessity somewhat involved, as frequent reference has to be made to the deliberations of the Commissions on which the resolutions of the Committee were largely dependent and which are set out in the form of appendices.

The International Meteorological Committee is appointed from time to time at Conferences of the Directors of the Meteorological and Magnetic Institutes and Observatories of the World for the intervals between conferences which are irregularly periodic. The period used to be about ten years; it is now normally six years. The Committee consists of sixteen members;* ultimately there will be twenty, who must be directors of national meteorological institutes, selected by a vote of the general assembly for their services to meteorology and geophysics. It has no separate funds, but has all the executive power and influence of the individuals of whom it is composed.

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* For the photograph in which the majority of the members of the Committee appear (reproduced as a frontispiece to this volume), taken in the Director's Room at South Kensington, we are indebted to Lady Shaw. The names, reading from left to right, are:—back row: Commandant J. Jaumotte, Belgium; Dr. Th. Hesselberg, Norway; Dr. L. Gorczynski, Poland; Mr. L. F. Richardson, Great Britain; Dr. G. Melander, Finland; Colonel L. Matteuzzi, Italy; Miss E. E. Austin, Great Britain. Front row: Dr. T. Okada, Japan; Dr. G. C. Simpson, Great Britain; Captain C. Ryder, Denmark; Professor V. Bjerknes, Norway; Sir Napier Shaw, Great Britain; Professor Dr. Maurer, Switzerland; Professor E. van Everdingen, Holland; Colonel F. A. Chaves, Azores.

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The Committee advises all the administrative authorities that have representation on the International Conferences and informs all the other meteorological organizations of the world. To the congresses and conferences of the past, within which the Committee originated, we owe the establishment of such uniformity as exists between various countries, in the manner of making observations, in the formulæ by which they are reduced, in the hours at which they are taken, and in the telegraphic codes whereby they are transmitted to neighbouring countries. The Conferences and the Committee have also in former years done much to organise co-operative researches by appointing commissions to discuss questions connected with Terrestrial Magnetism and Atmospheric Electricity, with Scientific Aeronautics, with Solar Phenomena and Radiation, with Maritime Meteorology and Storm Warnings, with Meteorology and Agriculture, also with the Réseau Mondial.

The efficacy of this organization depends on the fact that all the members of its central body, the Committee, are the directors of the meteorological establishments of their separate countries, and experience has shown that what the Committee recommends becomes the established practice. The function of the Committee is, in fact, to find out and set out in print the administrative points upon which the responsible meteorological authorities of different countries are agreed. The agreement so determined gradually covers all the activities of the meteorological services.

The organization of the Committee was of necessity interrupted by the war, but it had in part been resumed by a meeting of the members of the old Committee in London in July, 1919, and by a Conference of Meteorologists of Allied and Neutral Nations in Paris in the autumn of that year, at which the Committee and Commissions were re-appointed.

A meeting of the Commission for Weather Telegraphy was held in October, 1920, and the importance of the recommendations put forward made it desirable for an ordinary meeting of the Committee to be held at an early date. This was the more urgent on account of the retirement of Sir Napier Shaw from the directorship of the Meteorological Office, London, and the consequent resignation from his membership of the Committee. The Bureau arranged, therefore, to call a meeting of the Committee in London during the week September 12-17th, 1921, and arrangements were also made for meetings of the Commissions on Weather Telegraphy, Maritime Meteorology, the Application of Meteorology to Aerial Navigation, Polar Meteorology and the Réseau Mondial to be held during the previous week. Meetings of the Commission for the Investigation of Upper Air and of the Polar Commission had been held in Bergen in July.

The meeting sof the Committee were attended by the following members:—Sir Napier Shaw (President), Great Britain; M. A. Angot (Vice-President), France; Professor E. van Everdingen (Secretary), Holland; Colonel F. A. Chaves, Portugal, Azores; Director Th. Hesselberg, Norway; Commandant Jaumotte, Belgium; Dr. J. Maurer, Switzerland; Captain C. Ryder, Denmark; by the following Presidents of Commissions: Professor V. Bjerknes, Commission for the Upper Air; Colonel E. Gold, Commission for Weather Telegraphy; and Colonel J. Th. Saconney, Commission for Aerial Navigation; and by the following distinguished meteorologists: Colonel E. Delcambre, Dr. L. Gorczynski, Colonel Matteuzzi, Dr. G. Melander, Professor T. Okada, Dr. G. C. Simpson, Dr. A. Wallèn, Dr. S. Fujiwhara, and Mr. L. F. Richardson.

At the first meeting of the Committee two new members were elected, Dr. T. Okada, Director-designate of the Meteorological Service of Japan, in place of Professor Nakamura, resigned, and Dr. A. Wallèn, Director of the Meteorological and Hydrographical Service of Sweden. At the close of the meeting Dr. G. C. Simpson (Great Britain) and Colonel Delcambre (France) were elected in place of Sir Napier Shaw and M. Angot, who resigned their membership as being no longer directors of meteorological services.

The Committee was mainly concerned in the consideration of the reports presented by the Presidents of the various Commissions; among the more important matters submitted the following may be mentioned:—

(1) By the Commission for Weather Telegraphy: a revised international code for the transmission of reports from land-stations, and a new code for ships, drawn up in conjunction with the Commissions for Maritime Meteorology and Aerial Navigation.

(2) By the Commission for the Upper Air: scheme for the publication of international data for the upper air.

(3) By the Commission for Maritime Meteorology: the collection of oceanographical data.

The Committee approved a resolution of the Commission for the Réseau Mondial thanking the Director of the Meteorological Office for the publication of the Réseau Mondial and expressing the hope that the publication might be continued.

Among the subjects raised by individual members of the Committee it is of interest to note the proposal by Professor Nakamura for the early publication of details of the weather month by month, and the suggestion that such data would be of economic as well as of scientific importance; and a proposal by Colonel Matteuzzi for the publication of upper-air winds with a view to the construction of charts of lines of flow for various levels over Europe.

A suggestion by Colonel Delcambre for the more detailed study of clouds led to the appointment of a new Commission for the study of clouds and their stratification, of which Sir Napier Shaw was elected President.

The Committee emphasised the importance of promoting the study of the application of meteorology to agriculture by appointing as members of the Commission for that study experts in the agricultural world; the names of nine new members were added, two of whom, Messrs. R. H. Hooker and R. A. Fisher, represent the United Kingdom.

Before the close of the meeting the Committee proceeded to the election of the new Bureau. Sir Napier Shaw, though no longer qualified for ordinary membership of the Committee, which is confined to directors of meteorological services, was found eligible for the position of President, and was re-elected by the unanimous wish of the members. Professor E. van Everdingen was elected Vice-President in place of M. A. Angot, and Director Th. Hesselberg, Secretary.

During the meeting Colonel Chaves announced. that the Portuguese Government had expressed their appreciation of the work of the International Meteorological Committee by conferring upon Sir Napier Shaw (President), M. Angot (Vice-President), and Professor E. van Everdingen (Secretary) the Order of S. Tiago da Espada.

At the invitation of Professor E. van Everdingen, arrangements were made for a Conference of Directors, to be held at Utrecht in either the spring or autumn of 1923.

The Meeting at Rome of the International Union for Geodesy and Geophysics.

BY invitation of the Italian authorities the scientific activities of the Unions for Astronomy and for Geodesy and Ge physics were inaugurated at meetings held in Rome between May 2nd and May 10th of this year.

The Unions are under the ægis of the International Research Council, a new international organization mooted at Paris by representatives of the Academies of Science of the allied countries, and duly constituted at an assembly at Brussels in 1919.

Under the constitution, research in any subject which involves international co-operation may become in each country the care of a National Committee which formulates questions for consideration at an international meeting of the Union, and nominates delegates to attend the meeting and discuss the questions which they and their colleagues of other countries have propounded. The National Committee in each country is organized by its Academy of Science. We have, as yet, no Academy of Science in this country. The Royal Society discharges the international function.

Under the scheme of the Research Council a Union is a self-governing international organization subject to certain statutes which are the care of the Council, and it enjoys the administration of certain revenues derived from the fixed annual subscription of the States which " adhere " to the Union.

A Union has various sections, that of Geodesy and Geophysics comprises Geodesy, Land-Hydrology, Meteorology, Physical Oceanography (with a subsection for Tides), Seismology, Terrestrial Magnetism, Vulcanology. The business of each section is managed by a Bureau consisting of a President, one or more Vice-Presidents and a Secretary, amplified to an Executive Committee by the appointment of additional delegates as members.

At Rome the mode of procedure was to hold a plenary sitting of the Union on the first day to open the proceedings and to discharge or provide for any business which concerned the sections in common, and another on the last day to approve the distribution of the funds, and to wind up the proceedings of the assembly for that term.

A day in April was originally agreed upon for the meeting in Rome, but obsession by a Railway Conference caused its postponement until May, and as in Italy May 1st is a *dies non*, May 2nd, the earliest available date, was duly celebrated by a general assembly in the Gallery of the Conservators of the Capitol, at which H.M. the King of Italy and H.R.H. the Crown Prince were present with the two or three hundred delegates of the National Committees of the two Unions, to listen to five speeches of inauguration. The place on the left of the King was occupied by Cardinal Maffi, noted for his interest in physical science. The next day the two Unions met, each separately, in general assembly in the two great halls of the apartments of the Accademia dei Lincei in the Palazzo Corsini, a magnificent building just outside the walls, over the Tiber from the busy part of Rome.

The general assembly concluded, the respective sections met morning and afternoon for five or six days, Sunday being omitted. On Wednesday, the 10th, the Unions met again in general assembly to wind up their business, and agreed upon time and place for the next meeting. The Astronomical Union is to meet in Cambridge in 1925; the Union for Geodesy and Geophysics in Madrid in 1924.

The section for Meteorology met to discuss a paper of agenda comprising some formal preliminary business and eleven questions submitted by the National Committees as questions upon which international co-operation was required. The French National Committee proposed :—

(1) the different sorts of thunderstorms and electrical phenomena of the atmosphere,

(2) transparency and optical phenomena,
(3) the different sorts of clouds, and
(4) forecasting, particularly the method of barometric tendencies.

The British Committee:

(5) provision for observations of the Upper Air in places of special meteorological interest where there is no organized meteorological service,
(6) trajectories of air in three dimensions,
(7) the special exploration of the winds of the stratosphere,
(8) radiation in relation to " time-scale " in meteorological phenomena,
(9) the use of observations of atmospheric pollution in relation to visibility,
(10) the composition of the atmosphere in the highest levels.

The Italian Committee added a proposal—

(11) on the necessity for presenting the summaries of meteorological phenomena in other statistical forms than the arithmetic mean.

Other questions were added by permission of the section: one led to a resolution in favour of the continuance of the observations of solar radiation at the Observatory at Naples, which have been made for some time past and are in some danger. Another resolution encouraged the continuance of the Smithsonian observations of solar radiation for a further period.

Of the officers of the section, only the President, Sir Napier Shaw, was present; Professor di Marchi of Padua temporarily filled the place of Monsieur Angot, Vice-President, and Dr. Kimball that of Professor Marvin, Secretary; Professors Eredia of the Ufficio Centrale and Platania of Naples also gave their assistance as secretaries.

When the report of the Finance Commission was approved by the general assembly, the section found itself in control of about 20,000 francs of accumulated funds and 20,000 francs for each of the next three years.

The proceedings differed from those of the customary international meetings in having to provide for the judicious spending of a certain amount of money. The meeting authorised the spending of a sum on "jet-instruments" for obtaining deposits of atmospheric dust. These instruments are for presentation to the countries who adhere to the Union and are willing to make observations and forward them to the Bureau. It also authorized the spending of certain sums for the supply of instruments and material for balloon-sondes to competent persons in special localities, and the Bureau was instructed to make an appeal to Yacht Clubs and Aero Clubs for aid as regards personnel. It also authorised the provision of theodolites and material for the exploration of the stratosphere by pilot-balloons in the anticyclonic belt and other regions of clear atmosphere, and instructed the Bureau to appeal to the Directors of Astronomical Observatories erected in specially favourable situations.

The Bureau was further charged with other duties :—

(1) to report on the present position of our knowledge of radiation and its relation to the distribution of temperature in the atmosphere,

(2) to report on the requirements for dealing with the open question of the composition of the atmosphere at great heights,

(3) to invite the co-operation of *savants* of the various countries on the question of the details of convexion in the atmosphere, and

(4) to obtain from the meteorological services of the countries adhering to the Union a reasoned statement of the method of forecasting the weather in the respective countries.

The question of the statistical form for meteorological data was ordered to be referred to the International Meteorological Committee; and on the question of cloud forms persons interested were invited to communicate with the Commission on Clouds recently appointed by that body.

The Bureau has also to make enquiry of the International Meteorological Organization represented by the International Meteorological Committee as to the question of overlapping and of common action. The Bureau appointed to carry out these duties consists of Sir Napier Shaw, President; Colonel Delcambre and Professor Marvin, Vice-Presidents; Professor Eredia, Secretary. Professor Gamba, Dr. G. C. Simpson, and Director Wallèn were added to form an Executive Committee.

While the Meteorological Section was thus employed, the Sections for Geodesy, Physical Oceanography, Seismology, Terrestrial Magnetism and Vulcanology were equally occupied. The Section of Land-Hydrology was not constituted until the close of the meeting.

In Meteorology the line taken was to deal with administrative action in those questions which did not fall within the province of existing institutions or endowments. In Terrestrial Magnetism the paper of Agenda seemed to contemplate a review of the whole of the activity in the subject. In that Section Dr. Chree was president and Dr Bauer, secretary. The discussions were reported to occupy all the available time and to cover a wide range.

The proceedings of the meetings were enlivened by an evening party at the Campidolio given by the Municipality of Rome, an afternoon party at the Palatine Hill given by the Minister of Public Instruction, and excursions on Sunday to some of the many places of interest in the neighbourhood of Rome.

After the meeting some of the delegates proceeded on an excursion organized for the Physical Oceanographical Section to Sicily and Etna, others accepted invitations of the municipality of Florence to visit that beautiful city. There remained for some also the duty of assisting at the 700th Anniversary of the Foundation of the University of Padua.

The general organization of the sections was in charge of the President of the Union, Professor C. H. Lallemand, and the Secretary, Colonel H. G. Lyons, and the duty of local organization, which was admirably carried out, fell upon a Committee of which Professor Magrini of Venice was chief.

OFFICIAL NOTICES.

Reorganization of the Civil Aviation Department.

THE Under-Secretary of State has become the Member of Council responsible to the Secretary of State for Civil Aviation business. The Under-Secretary of State will act as Chairman of the Meteorological Committee, and for administrative purposes the Director of the Meteorological Office will be responsible to the Secretary of the Air Ministry. The Controllerate of Communications has already been placed under the Chief of the Air Staff. Major-General Sir W. S. Brancker, K.C.B., A.F.C., has been appointed Director of Civil Aviation as from May 9th, 1922.

The Royal Meteorological Society.

A MEETING of the Society was held on May 17th; Dr. C. Chree, F.R.S., President, in the chair.

Dr. A. E. M. Geddes.—Weather and the Crop Yield in the north-east counties of Scotland.—The paper was on the lines of Mr. R. H. Hooker's Presidential Address to the Society on January 18th (see *Meteorological Magazine*, 1922, p. 5), and dealt with the principal crops of the three counties, Aberdeen, Banff and Kincardine. A preliminary investigation covered the whole of eastern Scotland from Nairn to Fife, but there was not sufficient uniformity in all the conditions over this area to permit of useful deductions being drawn. Consequently the final investigation, which covered the years 1885 to 1919, was confined to three counties. The results indicate that in these north-east counties, cereals prefer a comparatively warm summer with rainfall somewhat in excess. Root crops show less connection with the weather than do cereals, but on the whole prefer a season with rainfall below the normal. The yield of hay was found to be influenced almost as much by the weather of the year previous to that of harvest as by the actual year of harvest. A comparison of these results with those obtained by Hooker for eastern England shows that the most important sections of the year, so far as the weather is concerned, vary from district to district, so that in any investigation of this nature care must be taken not to make the district too wide.

After the reading of the paper an important general discussion took place on Dr. Geddes' paper and on Mr. R. H. Hooker's Presidential Address, during which emphasis was laid on the value of the work and on the necessity for extending to it other districts. The President (Dr. C. Chree) pointed out that the stage which a crop had reached must have a great influence in determining whether rainfall or heat was beneficial at the time. Sir A. D. Hall (Agricultural Advisor to the Ministry of Agriculture) discussed the results from the agriculturalists' point of view, and called for co-operation between the meteorologist and plant physiologist. The effect of winter rains on wheat was, he thought, two-fold. Heavy rain washed the nitrates out of the soil, while a dry winter enabled the crop to establish a good root system. He thought it was unfortunate that we had not yet succeeded in making a good definition of growing weather, but had to consider rainfall and temperature separately.

Sir Thomas Middleton thought that Mr. Hooker had laid too much stress on the importance of the weather of the preceding year on the seed for the following year, and too little stress on the effect of weather in cleaning the ground. A dry autumn is unfavourable to weeds and so benefits the crop of the succeeding year. The unfortunate crop of 1916 was due, not to bad seed, but to war conditions causing bad farming. Dr. Geddes had found that north-east Scotland was too cold for oats and barley, while Mr. Hooker had found that eastern England was too hot; the optimum must therefore lie somewhere between. To elucidate this further, " dot diagrams " were necessary.

Mr. G. Udny Yule suggested that in place of dot diagrams solid models should be constructed showing the effect of rainfall and temperature on the crop in the same model. He thought that in the curves of correlation coefficients for barley and oats the close resemblance of form strongly supported the values found, though from the probable errors the results were barely significant. Mr. Yule also pointed out that what had been correlated with the weather was not in fact the yield, but the estimated yield, which might explain some of the differences. Mr. R. A. Fisher criticised Dr. Geddes' choice of periods, pointing out that they varied in length and did not overlap, so that it was impossible to regard his results as continuous functions, while the difference in length affected the value of the correlation coefficients.

Sir Napier Shaw looked for a further extension of Mr. Hooker's work to districts in the south and west. We had already obtained two important results: one was the conclusion that the optimum for barley lay somewhere between north-east Scotland and eastern England, by an extension of the process we could draw across the country a line of optimum conditions for barley; the other point was that the rainfall of the spring and summer had no influence on the root crop in Scotland, this could only mean that the average rainfall there was already the optimum. Sir Napier Shaw also referred to the necessity of selecting overlapping periods of uniform length in order to make the correlation coefficients into continuous functions. Mr. Hooker had already justified eight weeks. He wondered if it was necessary to go behind the direct simple correlations and calculate partials, since to the logical extension of that process there was no end. What we wanted was a bird's-eye view over a large extent of country as rapidly as possible. Major A. H. R. Goldie and Mr. J. E. Clark also spoke.

Mr. R. H. Hooker, replying to the various speakers, showed how the positive and negative correlation coefficients obtained fitted into their places in the curves representing the relation of crops to weather. If the average conditions fall on the left of the curve, the correlation will be positive; if on the right, the correlation will be negative. A zero correlation has two obvious explanations, either the weather at that particular point has no effect on the crop or we are at the optimum. The meteorologist supplied the figures; it was for the plant physiologist to interpret them.

Dr. H. P. Waran.—A new Form of Direct Reading Barometer.—In this paper Dr. Waran describes a barometer in which the height of the upper surface of the mercury is determined by observation of the reflection of a fixed vertical scale. The reflection is seen in a telescope and the cross-wire in the focal plane of the object glass gives the reading on the scale. No "setting" of the barometer is necessary. The invention is at present only in the experimental stage.

Correspondence.

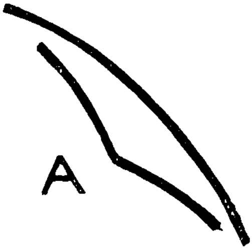
Optical Phenomena.

THE following observations ought perhaps to be put on record :—

1. On January 29th, 1922, off the north-west coast of Spain, a halo was observed. The radius was distinctly less than 22°. A rough measurement taken with a rule held at a known distance from the eye gave a radius of 16°, but the measurement was rough and may easily have been a degree or two out. Halos have been recorded at 14°, 16°, 17°, 17° 55′ and 19° 25′, and in the absence of exact measurement it is impossible to say which of these was the one observed on this occasion.

2. April 25th, 1922, at Stoner Hill, Petersfield, at 8h. G.M.T. and for about an hour afterwards, patches of cirrus coming from a northerly point showed optical phenomena. The halo of 22° was visible at times, and the two parhelia. The upper arc of contact of the 46° halo, or as it should perhaps be called the circumzenithal arc, was extremely brilliant. But the most remarkable phenomenon was a faint white paranthelion 99° east of the sun, the angle being measured with a sextant; this was seen twice in about a quarter of an hour, when patches of cirrus had drifted into the right position.*

3. On February 9th, 1922, about 90 miles north of Madeira, a little before sunset, a portion of a rainbow was observed on a slight shower from a rather degraded cumulus cloud; there was one supernumerary bow which was not symmetrical, but widened out as shown diagrammatically in the figure. The rain was evidently evaporating as it fell, and from the appearance only part of it could have reached the sea. Since the distance of the supernumerary bow from the primary is greater the smaller the drops, the latter must have been smallest at the point A. This is rather difficult to account for if the drops were evaporating as they fell; the only explanation that appears to be possible is that the drops in the shower were mainly of two different sizes, and that those of the smaller size were completely evaporated soon after passing the point A; at this point, on this theory, the proportion of small to large drops would have been a maximum.



C. J. P. CAVE.

Stoner Hill, Petersfield, May 31st, 1922.

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* It follows from Capt. Cave's data that the difference in azimuth between sun and paranthelion was the normal 120°.

Ice Pinnacles.

I WAS much interested to read the account of "ice pinnacles" in the *Meteorological Magazine* for April, for precisely the same phenomenon was observed here on the same day (February 5th last). It was also seen once before, on March 7th, 1917. On both occasions the pinnacles were confined to a relatively small area of the carriage drive on the north-east side of the house, where they were very numerous. Only two or three were seen elsewhere on the drive. Invariably each pinnacle was based on a small stone of the gravel, and the shape of the pinnacle (triangular, rectangular, etc.) was determined by the shape of the stone base. They were striated and apparently solid, for they could be picked up adhering to their stone bases, and when taken indoors they wasted away gradually.

The weather conditions were very similar on both occasions, but I particularly noticed that on February 5th there was very little wind, whereas on March 7th, 1917, a strong, bitterly cold east wind was blowing.

I should add that the gravel on which the pinnacles were observed was brought from Bournemouth, and is the only sample of its kind here, which might account for the very limited occurrence of the phenomenon, but, of course, neither the Bournemouth gravel nor the local soil here is at all chalky.

IVAN D. MARGARY.

Chartham Park, East Grinstead, Sussex, April 27th, 1922.

Solar Halo observed at Eskdalemuir, March 15th, 1922.

L'arc énigmatique observé le 15 mars dernier par Mr. Jarrold à Eskdalemuir était probablement un halo "secondaire." La lumière très vive émanant des cristaux qui donnaient le point le plus bas du halo de 22° a pû, en se réfractant de nouveau dans des prismes de 60°, produire un halo secondaire de 22°, ayant pour centre le bas du halo ordinaire de 22°.

Le même halo secondaire a été vu par Pernter en 1888 sur le Sonnblick (*cf.* "Meteorologische Optik," p. 379).

LOUIS BESSON.

Service Météorologique de la Ville de Paris, Paris, le 26 *mai,* 1922.

[M. Besson's communication adds to the interest of Mr. Jarrold's observation. Reference to Pernter's account shows that the secondary halo observed on the Sonnblick was well-developed and was accompanied by secondary parhelia. The centre was a brilliant patch of light 9° below the horizon, and Pernter mentions that this patch was probably the lower arc of contact of the 22° halo, which in such a case has a sharp bend and may give the effect of a mock sun. In the Eskdalemuir observation the circumstances were not so favourable.—ED. M.M.]

The Thunderstorms of May.

On May 21st a thunderstorm came up from the south-west and began at 5 p.m. The fall was at first heavy rain, but it soon turned to hail. The stones were of two sorts: (*a*) more or less spherical, from the size of peas to sparrow's eggs up to ¾in. in their longest diameter; and (*b*) irregular ovals of ice about ½ in. thick and up to 1¼ in. long with irregular finger-like projections. The storm was soon over, but after an interval of bright sunshine it came back from the north-east at 5.40 p.m., and this time the fall was chiefly of large hail-stones only, of both types.

Twenty of the larger stones collected after the second fall yielded 52 c.c. of water, an average weight of 2·6 grm., corresponding to ice spheres of ·74 in. in diameter.

The "Halliwell" gauge showed that ·25 in. fell in the first storm at the rate of 3·30 in. per hour, but shortly after the fall ceased and while the grass was still thick with stones, there were no unmelted stones in the funnel, suggesting that the larger stones jumped out, which seems quite likely, as they bounded up about a foot off the grass. It is therefore doubtful whether the rain gauges caught the full fall. The 8-in. ordinary gauge recorded ·35 in. for the two storms and the "Halliwell" ·38 in.

No damage of any consequence was done by the hail.

Henry Mellish.

Hodsock Priory, Worksop, May 26th, 1922.

A severe thunderstorm, accompanied by rain and hail, approached to-day from the west and south-west, travelling in an easterly direction, and at 6 p.m. reached its maximum. At 6.30 p.m. a second heavy storm arrived from the north, east, and west, and was at its maximum at 7.45 p.m. with very heavy rain and hail, accompanied by continuous thunder and lightning for two hours. The fall of rain for these two storms was 1·93 in.

G. E. Clayton.

Buckden, Skipton-in-Craven, May 22nd, 1922.

A thunderstorm passed over this house yesterday at about 7.30 a.m., and from the hail which fell for not more than 10 minutes I registered ·87 in. in my rain gauge.

Ambrose Boyson.

Synyards, Otham, Maidstone, May 26th, 1922.

DURING a sharp thunderstorm in the early morning of May 25th, three houses and a tree in different parts of Tunbridge Wells were struck by lightning within ten minutes and ·43 inch of rain fell between 6.10 and 6.15 a.m. (G.M.T.). This storm, however, was but a preliminary to what was to follow in the afternoon. At about 3 p.m., dark, copper-coloured clouds worked up from northward and from 3.2 to 3.17 p.m. thunder and lightning were continuous with rain and hail in torrents, the hail lying on the ground to a depth of a foot in places and being still in evidence the next morning. The rain measured immediately the storm ceased was 1·08 in., but practically all the hailstones, which varied from three-quarters of an inch to 2 inches in diameter, jumped out of the gauge, the actual fall being estimated at 1·37 in. during the 15 minutes. Considerable damage was done, holes being made through galvanised iron roofing. Where windows faced north or north-east scarcely a whole pane of glass was left and greenhouse roofs were completely demolished, the noise being like continuous machine-gun fire. The stones resembled in shape a small tangerine orange, and appeared to have a nucleus of water surrounded by coatings of clear and opaque ice.

Many freaks of the storms are reported. A house in Hawkenbury Road was considerably damaged by lightning during the morning. Fortunately no one was injured, but a lady in an adjoining house had her hands burnt. A girl, caught in the open in the afternoon storm was apparently struck, her arms being scorched by the lightning. She was further injured by the hail. Serious flooding occurred in the low-lying parts of the town, where the water level rose to the ceilings in some basement houses.

D. H. HORNER.

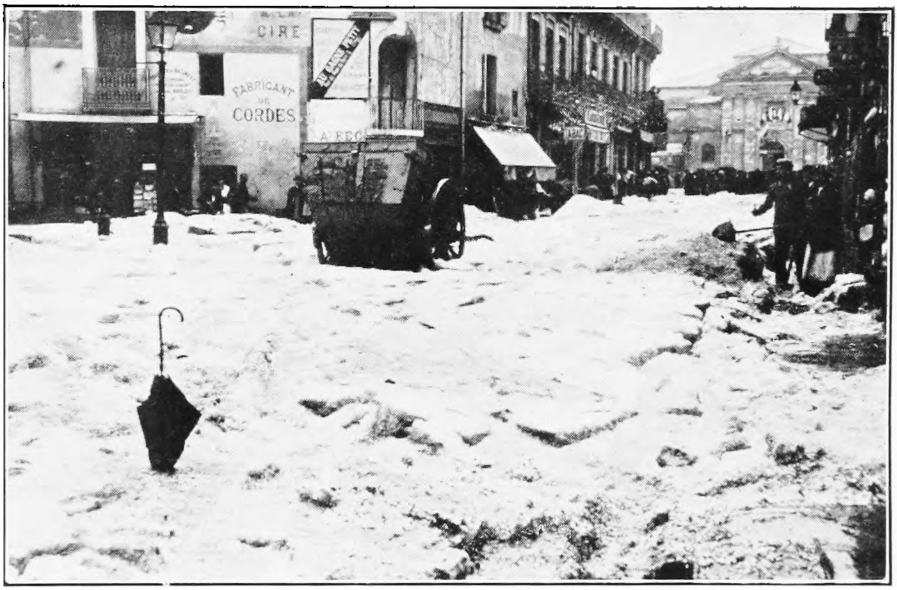
Sydenhurst, 47, *Forest Road, Tunbridge Wells, June 1st*, 1922.

THE following details of the hailstorm of May 25th may be of interest. Barometer was steady at 30·15 in., and the shade temperature was 81° F. The storm began at 5.50 p.m. (G.M.T.) with heavy rain and several flashes of lightning, the telephone wires near the church being struck. At 6.5 p.m. hail commenced, suddenly increasing in size but diminishing in the number of stones to about one per square yard. The size of the stones was about that of a golf ball. The storm ceased abruptly by 6.20 p.m., the precipitation having been ·18 in.

The storm clouds travelled over Mildenhall from south to north-north-east. By 6.45 p.m. there was bright sunshine, the temperature being 79° F. and the barometer 30·18 in., rising.

H. R. W. FORSTER.

Mildenhall, Suffolk, May 26th, 1922.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FABRICANT DE CORDES

VIEW IN MONTPELIER AFTER THE HAILSTORM OF MAY 13TH, 1922.

An Exceptional Hail Shower.

On May 13th, 1922, between 15 h. 30 m. and 16 h. the town of Montpellier and its surroundings experienced a severe thunderstorm, with a quite remarkable hail shower. The hail stones were about 10 or 15 millimetres in diameter with a weight of 3 to 5 grammes. On open ground after the storm the depth of the layer was about 10 centimetres. In many streets rain overflowed and hail stones were caked together in lumps, being in places some 50 or 60 centimetres deep.

The traffic was blocked, and clearing by military fatigue parties was necessary as after a blizzard.

Happily, this exceptional shower was restricted to a limited area of half a kilometre wide and 5 or 6 kilometres long. The damage was, of course, considerable, but without any personal casualty.

MARCEL MOYE.

University of Montpellier, France, May, 1922.

"Sea Breezes" on the Lincolnshire Coast.

Very interesting examples of the afternoon "sea breeze" have been experienced at Skegness. On May 21st my shade thermometer rose steadily from 59° F. at 8 a.m. (G.M.T.) to 76° F. at 2 p.m., with a light wind varying slightly but about south. Shortly after 2 p.m. gusts of cool air came from east and north-east, the temperature falling to 71° F. at 2.30 p.m. and to 67° F. at 3 p.m., a drop of 9° in one hour, with clear sunshine. Later the wind veered to south-east and south, with a slight rise in temperature after 7 p.m.

On May 22nd, a similar event occurred. After a cloudless warm morning, with the thermometer rising from 67° at 8 a.m. to 79° at 1 p.m., cool air came in off the sea, the temperature falling to 72° at 2 p.m. and 69° at 3 p.m.

The formation of cumulus cloud to landward each afternoon seemed to indicate an upward current. On the second day these clouds rapidly developed into cumulo-nimbus, and a thunderstorm broke at 3.45 p.m.

May 23rd was even more noteworthy. A sea breeze prevailed till 1 p.m., when the thermometer showed 69°. The wind then veered to about south-west, and at 1.30 p.m. it reached 80°. At 3.30 it stood at 82°, a very high reading for this coast in May, I should imagine, when a sudden breeze from the sea lowered the thermometer to 69° at 4 p.m., a drop of 13° in half an hour.

To-day, with a continuous wind from about north, I have noticed nothing above 65°. The temperature at 3 p.m. was 21° lower than that of the same time yesterday.

ARNOLD B. TINN.

9, *St. Andrews Drive, Skegness, May 24th,* 1922.

Simple Weather Forecasting.

MAY I point out that Mr. Robertson and I—writing to the *Kent and Sussex Courier* on May 5th, 1921, the forecast being published on May 13th—stated that " a very warm early summer, with considerable drought and water shortage, may be expected, the fine weather being broken only by severe local thunderstorms." A similar forecast appeared in the *English Mechanic and World of Science* for May 27th. If it was not " forecasting the drought " which subsequently eventuated, I do not know what it was! It certainly did prove of great benefit to those agriculturists who believed in the forecasts and therefore laid their plans accordingly, but the majority of the farming community are too conservative to avail themselves of new ideas.

D. W. HORNER, F.R.A.S., F.R.Met.Soc.

Tunbridge Wells, April 4th, 1922.

IN your note on *Simple Weather Forecasting* (April, 1922) you show the unreliability of general predictions, which to my mind is often caused by the vagueness of the language used. The word " Spring " is a case in point, as " Spring " arrives at such different dates according as the observer lives in a cold or hot country; our Celtic Spring begins on February 2nd (Candlemas Day).

We have another common saying here :

> " The wind blowing at Midnight of the Eve of March 21st will be the prevailing wind for the next three months,"

and old men go out on that eve to know what to expect.

THEREZA STORY MASKELYNE.

Basset Down, Swindon, Wilts. April 21st, 1922.

[In Hampshire the saying is :

> " Where the wind is on the 21st of March, there she'll bide for the next three months,"

and they also say in Hampshire that the wind blowing on Palm Sunday will be the prevailing wind for the greater part of the Summer. Both these sayings are quoted in *A Medley of Weather Lore* by M. E. S. Wright, the first one being ascribed to Surrey as well as to Hants. It is curious that March 21st itself should be mentioned in one locality, while in another it is the eve of that day that is significant.

Mr. Inwards in his *Weather Lore* quotes Dr. Kirwan :

> " When there has been no particular storm about the time of the Spring equinox, if a storm arise from the east on or before that day or if a storm from any point of the compass arise near a week after the equinox then, in either of these cases, the succeeding summer is generally *dry*, four times in five; but if a storm arise from the south-west, or west-south-west, on or just before the Spring equinox, then the Summer following is generally *wet*, five times in six."

—ED. M.M.]

NOTES AND QUERIES.

Sunspots and Summer Rainfall.

Mr. A. B. Macdowall has called attention to a parallelism between the rainfall at Rothesay during July and August and the sunspot numbers. In the accompanying diagram,* the upper curve shows the rainfall for these two months smoothed by averaging over periods of five successive years; the mean being entered to the middle year of the series. The lowest curve shows the mean annual relative sunspot numbers. The agreement is very good between 1820 and 1870, during the period of strongly accentuated sunspot maxima, but tends to break down before and after those dates. The second curve which is referred to the same zero as the first shows the corresponding July and August rainfall for Greenwich, completed for early years by the readings at the Royal Society, given by Luke Howard in his *Climate of London.* This Greenwich curve by itself shows no particular relation to the sunspot curve, but when the differences between I. and II. are taken, as in curve III., the agreement is even more marked than in the case of the Rothesay figures alone. It is to be noted that the scale of curve III. is double that of the first two.

The dates of the successive maxima are set out in the following table:—

Dates of Maxima.

Sunspots. S.	Rothesay Rain. R.	Greenwich Rain. G.	Difference. R–G.
1804	1809	1806	1809
1816	1816	1815, 22	1816
1830	1829	1830	1825
1837	1838	1841	1837
1848	1848, 50	1853	1848
1860	1860	1867	1861, 63
1870	1875	1877, 79	1871
1883–4	1883	1890	1883
1894	1894	1903	1894, 98
1905	1905	1910	1905
1917	? 1919	1917	—

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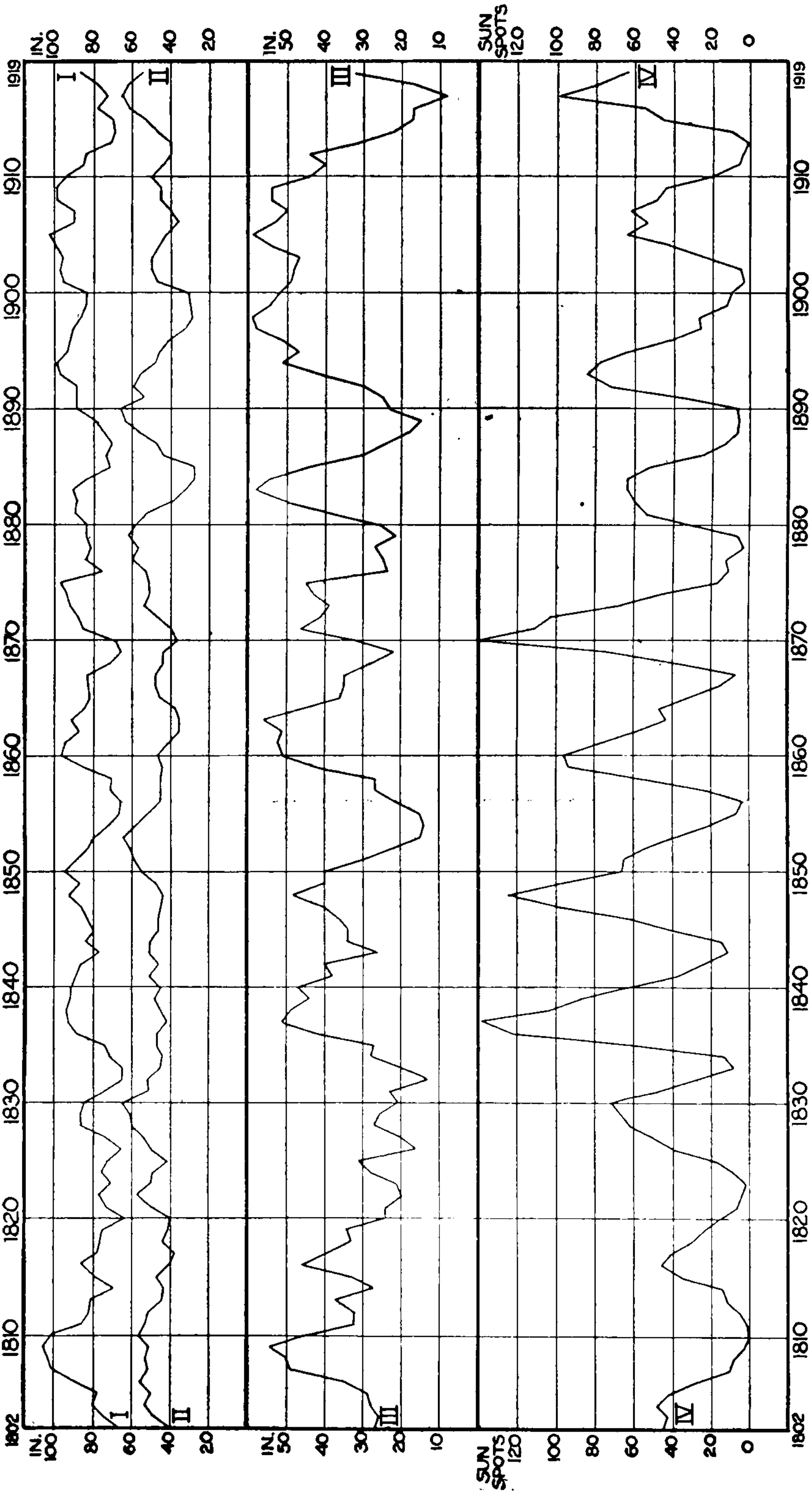
* The rainfall data for Rothesay were supplied by Mr. Macdowall, the rainfall data for Greenwich were taken from the tables (1815–1903) by W. C. Nash in the *Q.J.R. Meteor. Soc.*, Vol. XXX., 1904, p. 291, and completed from manuscript records in the Meteorological Office; the sunspots numbers were taken from the *M.O. Calendar.*

The correspondence between Rothesay summer rainfall (July and August) and sunspot numbers was first brought out by Mr. Macdowall in a note to the *Meteorologische Zeitschrift*, Vol. XXIV., 1907, p. 514.



Summer Rainfall and Sunspots.—I., Rainfall at Rothesay, July–August; II., Rainfall at Greenwich, July–August; III. = I.–II. (vertical scale doubled); IV., Annual Sunspot Numbers.

The chief disagreements occur about 1804 and 1870. At the sunspot maximum of 1804, Rothesay rainfall, Greenwich rainfall, and the difference between them, were all near a minimum, and all showed a maximum near the succeeding sunspot minimum of 1809–11. The pronounced sunspot maximum of 1870 is accompanied by minima at Rothesay and Greenwich, but the difference between them is rapidly increasing and rises from a minimum in 1869 to a maximum in 1871. It is interesting to notice that each of these dates, 1804 and 1870, corresponds to a change of the sunspot curve from steep to flattened maxima.

From 1874 to 1893 the difference curve shows a remarkable parallelism with sunspots, though the separate curves for the individual records diverge considerably from the sunspot curve. After 1893 the agreement is not particularly good.

It appears that the relationship is not nearly so marked when June is included, though it is difficult to suggest a reason why it should be limited to July and August.

Monthly Meteorological Charts for Western Europe.

TOWARDS the end of the war the Intelligence Division of the Naval Staff for the Hydrographic Department of the Admiralty undertook the preparation of monthly meteorological charts for Western Europe which would particularly meet the needs of seamen. The work was carried out under the direction of the late Prof. H. N. Dickson, C.B.E., M.A., D.Sc., and the charts are now available for the public.

Ten charts for each month show the average monthly values of certain meteorological elements at selected stations in Western Europe. So far as the information has been available averages have also been given for localities over the sea. This has been done by using information derived from the Danish Meteorological Annual and the United States of America North Atlantic Pilot Chart, in addition to the data supplied by the Meteorological Office. It is inevitable, however, in charts of this kind that large areas on the maps should have to be left blank.

Notable features of the charts are fog-roses, "showing fogs with winds in octants per 1,000 observations"; average monthly isotherms of sea temperature drawn for every 1° F.; charts showing the average number of days of snow per month; and charts showing the average number of days of thunder per month.

The charts are preceded by tables in which monthly average values of temperature, precipitation, vapour pressure, relative humidity and sunshine are given for selected stations in the British Isles. For foreign stations the average number of days per month with (*a*) maximum temperatures; (*b*) minimum temperatures; and (*c*) rainfall, between certain limits is shown in the tables.

Most of the averages have been based on a comparatively long series of years (20 years or more), but in some cases (notably relative humidity averages) a period of eight or ten years has been used. In the case of the "Supplementary Meteorological Data," showing the average number of days of (1) hail; (2) clear sky; (3) overcast sky; (4) fog; (5) gale; the ten years 1906-1915 have been used.

The charts should be particularly useful and interesting to seamen. For example, it can be seen at a glance that a fog is hardly ever experienced in the Hebrides in January; that a south-west wind at Pembroke is much more likely to be accompanied by fog than a wind from any other direction, especially in the spring and early summer; that an east wind at Brest is seldom strong in August, but a west wind in the same month is as often fresh or strong as not; that a thunderstorm is rarely experienced at Lerwick in June, but that at Bordeaux the chances of a thunderstorm occurring on any day in that month are about one in six.

The Colour of Lightning.

A CORRESPONDENT calls attention to the statement in *The Times* commenting on the blue colour of the lightning during the thunderstorm of February 2nd, and points out that the flashes observed from Oxford, numbering four or five, between 15 h. 15 m. and 15 h. 35 m. on that day were distinctly reddish. The storm did not pass directly over Oxford, and the window from which the lightning was observed faces west. Another observer, facing east, commented independently on the redness of the forked lightning.

No doubt the explanation is that the blueness of the lightning seen in London was really a subjective effect due to the brilliancy of very near flashes. The brighter the light the more blue it appears. On the other hand the redness might be due to two causes. Real red flashes are not unknown, but rosy flashes are more common. These red flashes are supposed to be due to the discharge passing through hydrogen derived from the dissociation of water; hydrogen has many lines in the red.

In the present case the redness as seen from Oxford was probably simply due to atmospheric absorption. Distant lightning appears red for the same reason as the sun and moon appear red when near the horizon. This would be very likely with the turbid atmosphere of a winter afternoon.

The Horse Latitudes.

SEVERAL correspondents are to be thanked for references to explanations of the term "Horse Latitudes." The earliest of the references in the Oxford Dictionary is as follows:—

> 1777. G. Forster. *Voyage round the World*, II., 581. "The latitudes where these calms chiefly reign are named the horse latitudes by mariners because they are fatal to horses and other cattle which are transported to the last mentioned continent [America]."

The tradition of English seamen is in accordance with this quotation. On the other hand, Maury (*Physical Geography of the Sea*, 1866, p. 276) places the fatal region farther west.

> The horse latitudes are the belts of calms and light airs which border the polar edge of the north-east trades. They were so called from the circumstance that vessels formerly bound from New England to the West Indies with a deck-load of horses were often so delayed in this calm belt of Cancer, that for the want of water for their animals, they were compelled to throw a portion of them overboard.

An alternative interpretation of the term, which Commander L. G. Garbett tells us is "more familiar still" to most sailors, is as follows:—

> In sailing-ship days, crews always received a month's advance (pay) before leaving a home port; this had to be worked off during the first month at sea, and to celebrate the expiration of this period an empty tar-barrel known to sailors as the "dead horse," was hoisted to the end of the fore-yard arm, set on fire and dipped in the sea. The latitudes in which this occurred were known as "The Horse Latitudes."

Laughton, in his *Physical Geography*, 1870, p. 24, says:—

> Between the westerly winds and the north-east winds there is a part of the ocean where the winds are of the most changeable character . . . it lies for the most part between the meridians of 30° and 55° W. . . . Winds from all quarters and dead calms occur in very nearly equal proportions. Severe gales are common and the same uncertainty exists with regard to them that exists with regard to the general direction of the wind; they blow from all quarters, but perhaps most frequently from the south-west. Speaking roughly, this part of the ocean lies between the Azores and Bermuda, and at a very early period in Atlantic navigation received from the Spaniards the name of *el golfo de las yeguas*, the mares' sea, in allusion to its boisterous nature and in contradistinction to *el golfo de las damas*, the ladies' sea, as the trade-wind region was called from its being so smooth and pleasant to sail over. It is this name, *el golfo de las yeguas*, which our sailors translated into 'the Horse Latitudes,'* and the story of ships laden with horses being becalmed there so long that they had to throw their cargo overboard was probably invented at a comparatively recent date to account for the name which the region had so long borne.

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* There are, however, many instances in English in which the word "horse" is used as a prefix denoting boisterous; as, for instance, *horse-laugh*, *horse-play*.

Remarkable Temperatures in the Argentine and South Georgia.

We learn from Mr. R. C. Mossman that on the morning of April 26th at Buenos Aires, the shade minimum fell to 27·9° F., and the grass minimum to 20·5° F. The previous April shade minimum (1861–1921) was 33·4° F., and the frost caused much damage to fruit trees and garden plants. The occasion of this low temperature was a high-pressure area which passed across South America from west to east, causing strong southerly winds in its front.

Mr. Mossman also reports that at Grytviken (South Georgia) the shade maximum on March 10th last rose to 83·8° F., which is 13° above the previous record. This is attributed to an intense Föhn effect. About the same time, probably on the same day, the shade maximum in the South Orkneys rose to 51·4° F., which is only one degree below the absolute maximum.

The Highest Aeroplane Ascent.

With reference to Major Schroeder's ascent at Dayton, Ohio, referred to in this magazine for March 1920 (p. 25) and April 1922 (p. 75), we are informed by the Royal Aero Club, which is the official British representative on the Féderation Aeronautique International, and thus the body responsible for deciding on records, that the official figures for Major Schroeder's flight are 33,114 feet (10,093 metres), not 36,000 feet as previosuly stated. A new record of 10,518 metres (34,500 feet) has since been set up by J. A. McCready in a flight at Dayton on a Lepère machine with a 400-h.p. Liberty engine, during September, 1921.

The Writing on the Sky.

The recent successful attempts at smoke-writing by aeroplane carried out by the *Daily Mail* open up fascinating possibilities in regard to the study of atmospheric movements which may well have great meteorological significance. Taylor's work on atmospheric turbulence has brought this subject into prominence and demonstrated its importance in regard to weather, but the actual movements of the air in detail are extremely difficult to observe, and there appears every reason to hope that the movements of smoke emitted from aeroplanes, or possibly even better from stationary balloons, may throw much light on the subject.

The Value of Wireless.

THE Calcutta correspondent of the *Daily Mail* states that the broadcasting by wireless of information as to an approaching cyclone was recently picked up by no fewer than 450 wireless stations in Bengal. As many as eight large ships were enabled to alter their courses in order to avoid the storm, which was one of the worst known in the Bay of Bengal for many years, the wind velocity reaching 100 miles per hour.

Review.

Ceylon Rainfall: Monthly Averages. Memoirs of the Colombo Observatory, No. 3. By A. J. Bamford, B.Sc., B.A., M.C., Colombo, 1921. Size 13 × 8¼, pp. 3, 13 plates.

THE rainfall of islands is usually interesting on account of its relative simplicity. That of Ceylon is particularly instructive as it presents some peculiar features. These, Mr. Bamford's long experience enables him to bring out with great clearness.

The maps embodied in the memoir show the distribution of the average fall during each month of the year. It is unfortunate that no attempt appears to have been made to synchronize the records, which vary in length from 50 to 5 years, but the comparatively small number of stations in the north and part of the east probably makes this impossible. The author emphasises the value of voluntary co-operation in observing.

The main control of the rainfall of the island is definitely monsoonal. In the months of the northern summer, May to September, the south-west monsoon brings a large fall in the south-western hill slopes; but on the lee side of the high land pronounced rain-shadows exist. During the northern winter months, November to February, the north-east monsoon brings a similar, but less marked, maximum in the north-east, but the rain-shadow effect is not so definite. In the intermediate months, when the monsoon winds are not blowing, the land and sea breezes are able to become established and convectional thunder rains develop. In November some cyclonic rain falls.

Monsoonal rains fall nearly uniformly throughout the day and cyclonic rains have no definite diurnal variation, but convectional rains, especially in the tropics, tend to a marked afternoon maximum. An excellently devised diagram, comparing the diurnal range in each month in the east and west of the island, takes advantage of these facts to analyse the prevailing types at each season.

The Weather of May, 1922.

In the first week of May the British Isles were under the influence of a series of depressions passing to the southward of Iceland, and, as a result, unsettled, changeable weather was experienced. Moderate rainfall was reported from many stations. On the 3rd of May several places in the south-west of England recorded about 10 mm. During this period pressure was relatively high to the north of Scandinavia and over the Azores.

The formation of an anticyclone over France about the 6th began immediately to affect conditions in the south-east of England, and by the 9th the whole of the British Isles lay under high pressure extending from Iceland to the south of France and very fine warm weather was experienced generally in Great Britain and France. Temperature rose above 80° F. in parts of London and exceeded 85° F. locally in France. During this period a deep depression existed over Scandinavia with a very steep gradient for northerly winds, giving gales accompanied by snow, sleet and hail in many places. The centre of the high pressure area moved slowly north-westward, and on the 12th it was situated between Iceland and the Azores, causing a northerly wind current over the British Isles generally with a marked fall in temperature. The presence of a low-pressure system on this date over central and south-west Europe gave rise to heavy local rains, 37 mm. being reported from Zurich, 33 mm. from Berne, and 18 mm from Munich.

A depression which made its appearance to the west of Iceland on the 12th moved in an easterly direction causing heavy northerly gales in Iceland with considerable falls of snow and also affected the north-west districts of the British Isles. On the 14th a high-pressure system extended from the Azores across south-west and central Europe, and fine weather with light winds prevailed generally in these districts. At the same time, in northern Europe a depression centred between Iceland and the Faröe Islands moved eastward and strong winds prevailed during its passage, gale force being reached at Blacksod Point. On the 15th the Atlantic depression moved slowly eastwards, causing much rain in Ireland and Scotland; 33 mm. being reported from Glasgow, 21 mm. from Nairn, and 17 mm. from Valencia and Castlebay. An anticyclone extended from the Azores to Austria, and pressure was relatively high over southern England. Fair weather prevailed over the whole of this area. Pressure was low in the western Mediterranean and 26 mm. of rain fell at Perpignan.

Conditions remained almost unchanged until the 20th, when the continental anticyclone moved slowly eastward and a ridge of high pressure extended northward from France to Scandinavia. A V-shaped depression over the Atlantic to the west of the British Isles moved slowly north-eastward and brought rain to the north and west of the kingdom. Snow occurred in Iceland, while rainfall amounted to 18 mm. at Valencia, 14 mm. at Birr Castle, and 12 mm. at Lerwick. In the anticyclonic area some high temperatures were reached—88° F. at Bordeaux and 79° F. at Paris. On the 22nd thunderstorms occurred locally in England, 11 mm. of rain being recorded at Nottingham and 7 mm. at Cranwell.

Around the period 22nd-24th very exceptional heat developed inland over south-east England, reaching a maximum of 88° F. at South Farnborough on the 22nd, 89° F. at Grain on 23rd, 86° F. and 88° F. respectively at Kew and South Farnborough on the 24th. High night minima also prevailed, varying between 58° F. and 62° F. On the 24th 101° F. was reached at Neufahrwasser, 96° F. at Paris and 95° F. at Frankfurt.

During the 25th a depression to the south-west of Iceland moved in a north-easterly direction to the Faröe Islands, and the cyclonic circulation of winds round it increased considerably in force. Slight rain was experienced generally in Iceland, on the west coasts of Scandinavia, and in the north-west districts of the British Isles. Sleet and snow occurred locally in Iceland, at Jan Mayen, and in the extreme north of Scandinavia.

On the same afternoon heavy thunderstorms occurred locally in London and south-east England. During the 26th the northern depression moved slowly north-eastwards to Scandinavia and caused strong winds rising to gale force in exposed places. Heavy rain occurred along the coasts of central Norway, 19 mm. falling at Florö and 11 mm. at Bronnö. In this period, temperature was lower generally than on the preceding few days, though 95° F. was registered at. Perpignan, 86° F. at Lyons, 84° F. at Frankfurt and several other places. By the morning of the 28th the continental anticyclone had extended northwards over Scotland and the North Sea as the depression over the Scandinavian coasts receded north-east, but a fresh depression was indicated offthe south-west of Iceland. Cloudy or overcast weather prevailed in the eastern Mediterranean and along the north African coasts owing to shallow areas of low pressure. At Athens 8 mm. of rain fell. In the anticyclonic regions the weather was generally fine and warm, temperatures of 91° F. being recorded at Lisbon and Neufahrwasser, 90° F. at Aachen, over 80° F. in parts of France and Germany, and over 70° F. inland in England.

On the 29th, apart from the extreme north of Scotland, which was under the influence of a small secondary, the weather over the Continent and the British Isles generally was fine and accompanied by high temperatures. At Bordeaux 91° F. was reached, at Rome 88° F., at Nice 86° F., while in some parts of England 75° F. was registered. The temperature at Spitzbergen at 13h. G.M.T. was, however, only 21° F. The anticyclone was maintained till the end of the month, and temperature again exceeded 80° F. in many parts of Europe, notably 92° F. at Limoges, while 80° F. was exceeded locally in the south-east of England. G. H.

At the beginning of the month the Garonne was nearly 10 ft. above normal level and parts of Toulouse were under water. In consequence of persistent rain the Seine rose so high that the Paris steamboat service had to be stopped for a few days. The river has not been so high since the great floods of 1910. Towards the end of the month very hot weather was experienced in northern France, especially in Paris,where a temperature of 92° F. was recorded on the 24th. This is the highest May temperature experienced for at least 50 years, and in spite of the great rise of the Seine earlier in the month the water supply has to be restricted in places.

At Flushing a temperature of 94° F. was registered on the 24th. This is the record for any month.

The annual avalanche known as the "red avalanche," which falls every spring near Goppenstein, at the southern end of the great Lötschberg tunnel in the canton of Valais, Switzerland, fell on April 22nd, temporarily blocking the line. During April 244 mm. of rain fell at Geneva, the highest figure previously recorded in that month being 162 mm. in 1799; more rain has already fallen this year than during the whole of 1921. A great avalanche fell early in May in the Casque de Borée, above St. Gingolph (Valais), in a spot where no similar occurrence has been recorded for a century. An avalanche also swept away the new Fergenhogel hut, above the Klosters, at an altitude of 7,200 feet. At the end of the month Switzerland was experiencing the high temperature of western Europe.

The P. and O. steamship "Egypt" was sunk at 19h. on the evening of Saturday, May 20th, by collision with the French steamer "Seine," with the loss of 96 lives. The accident took place 28 miles off the Armen lighthouse on the coast of Finistère. Anticyclonic conditions prevailed over western Europe with the result that warm air was passing in a north-westerly direction from northern Africa and the western Mediterranean, giving rise to dense sea fog at the mouth of the English Channel.

Early in the month there was more snow lying on the mountains north

(*Continued on p.* 148.)

Rainfall Table for May 1922.

STATION.	COUNTY.	Aver. 1881–1915.	1922.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	1·76	·83	21	47	·24	3	7
Tenterden (View Tower)	*Kent*	1·57	·67	17	43	·36	1	7
Arundel (Patching Farm)	*Sussex*	1·85	·93	24	50	·27	16	9
Fordingbridge (Oaklands)	*Hampshire*	2·08	·85	22	41	·34	16	10
Oxford (Magdalen College)	*Oxfordshire*	1·79	1·60	41	89	1·08	24	8
Wellingborough (Swanspool)	*Northampton*	1·94	1·20	31	62	·55	24	11
Hawkedon Rectory	*Suffolk*	1·85	1·12	28	61	·19	25	11
Norwich (Eaton)	*Norfolk*	1·93	·58	15	30	·09	12,17	12
Launceston (Polapit Tamar)	*Devon*	2·02	1·39	35	69	·43	16	9
Sidmouth (Sidmount)	,,	1·96	·64	16	84	·19	16	8
Ross (County Observatory)	*Herefordshire*	2·13	·44	11	21	·09	4	9
Church Stretton (Wolstaston)	*Shropshire*	2·58	1·25	32	48	·39	4	9
Boston (Black Sluice)	*Lincoln*	1·76	1·36	35	77	·54	1	11
Worksop (Hodsock Priory)	*Nottingham*	1·99	1·17	30	58	·35	21	8
Mickleover (Clyd House)	*Derbyshire*	1·97	1·00	25	51	·33	22	8
Southport (Hesketh Park)	*Lancashire*	2·09	1·66	42	80	·56	16	14
Wetherby (Ribston Hall)	*York, W. R.*	2·07	·82	21	40	·27	16	5
Hull (Pearson Park)	,, *E. R.*	1·93	1·18	30	61	·68	22	11
Newcastle (Town Moor)	*North'land*	2·03	1·12	28	55	·56	16	11
Borrowdale (Seathwaite)	*Cumberland*	7·37	6·00	152	81	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	2·50	1·45	37	58	·58	16	12
Haverfordwest (Gram. Sch.)	*Pembroke*	2·50	..	..	..	..	..	..
Aberystwyth (Gogerddan)	*Cardigan*	2·64	1·98	50	75	·63	4	5
Llandudno	*Carnarvon*	1·90	·28	7	15	·06	1	10
Dumfries (Cargen)	*Kirkcudbrt.*	3·01	2·68	68	89	·48	6	15
Marchmont House	*Berwick*	2·47	·67	17	27	·14	15	9
Girvan (Pinmore)	*Ayr*	2·98	3·24	82	109	·95	15	15
Glasgow (Queen's Park)	*Renfrew*	2·44	2·62	67	107	1·08	15	14
Islay (Eallabus)	*Argyll*	2·65	4·22	107	159	1·18	15	15
Mull (Quinish)	,,	3·06	6·59	167	215	2·02	15	23
Loch Dhu	*Perth*	4·49	6·80	173	151	1·70	4	17
Dundee (Eastern Necropolis)	*Forfar*	2·09	·94	24	45	·18	21	14
Braemar (Bank)	*Aberdeen*	2·38	1·42	36	60	·30	21	10
Aberdeen (Cranford)	,,	2·48	1·00	25	40	·38	15	12
Gordon Castle	*Moray*	2·12	1·96	50	92	·97	15	12
Fort William (Atholl Bank)	*Inverness*	3·99	11·86	301	297	2·63	15	20
Alness (Ardross Castle)	*Ross*	2·60	3·30	84	127	1·29	15	23
Loch Torridon (Bendamph)	,,	4·56	10·25	260	225	1·65	15	20
Stornoway	,,	2·56	4·85	123	190	·55	7	23
Loch More (Achfary)	*Sutherland*	4·40	7·97	202	181	·96	14	30
Wick	*Caithness*	2·07	1·83	47	88	·39	15	19
Glanmire (Lota Lodge)	*Cork*	2·45	1·69	43	69	·57	15	14
Killarney (District Asylum)	*Kerry*	3·06	2·38	61	78	·41	21	17
Waterford (Brook Lodge)	*Waterford*	2·32	1·44	37	62	·43	16	11
Nenagh (Castle Lough)	*Tipperary*	2·47	2·00	51	81	·48	20	15
Foynes	*Limerick*	2·33	1·64	42	70	·42	21	17
Gorey (Courtown House)	*Wexford*	2·22	1·24	31	56	·53	16	7
Abbey Leix (Blandsfort)	*Queen's Co.*	2·43	1·60	41	66	·40	15	11
Dublin (FitzWilliam Square)	*Dublin*	2·05	·61	15	30	·20	17	13
Mullingar (Belvedere)	*Westmeath*	2·45	2·08	53	85	·65	20	11
Crossmolina (Enniscoe)	*Mayo*	3·25	..	..	..	..	..	..
Collooney (Markree Obsy.)	*Sligo*	2·80	1·49	38	53	·32	21	18
Seaforde	*Down*	2·63	1·77	45	67	·58	17	11
Ballymena (Harryville)	*Antrim*	2·86	1·86	47	65	·32	17	13
Omagh (Edenfel)	*Tyrone*	2·59	3·07	78	119	1·00	21	16
Letterkenny Asylum	*Donegal*	2·80	1·80	46	64	·45	21	18

Supplementary Rainfall, May 1922.

Div.	STATION.	RAIN.		Div.	STATION.	RAIN.	
		in.	mm.			in.	mm.
II.	Ramsgate...........	·50	13	XII.	Langholm, Drove Rd.	3·35	85
,,	Sevenoaks, Speldhurst	2·45	62	XIII.	Ettrick Manse........	3·17	80
,,	Hailsham Vicarage...	·79	20	,,	North Berwick Res....	·70	18
,,	Totland Bay, Aston Ho.	·70	18	,,	Edinburgh, Royal Ob.	·67	17
,,	Ashley, Old Manor Ho.	·85	22	XIV.	Biggar................	2·63	67
,,	Grayshott...........	·99	25	,,	Leadhills	4·87	124
,,	Ufton Nervet........	·82	21	,,	Kilmarnock, Agric. Coll.	3·67	93
III.	Harrow Weald, Hill Ho.	1·04	26	XV.	Dougarie Lodge.......	3·09	79
,,	Pitsford, Sedgebrook..	1·02	26	,,	Oban................	7·05	179
,,	Chatteris, The Priory.	1·18	30	,,	Holy Loch, Ardnadam	7·15	182
IV.	Elsenham, Gaunts End	1·01	26	,,	Tiree Cornaigmore....	..	..
,,	Lexden, Hill House ..	1·07	27	XVI.	Loch Venachar	5·45	138
,,	Aylsham, Rippon Hall	·88	22	,,	Glenquey Reservoir ...	5·80	147
,,	Swaffham...........	·77	20	,,	Loch Rannoch, Dall...	3·44	87
V.	Devizes, Highclere ...	·79	20	,,	Blair Atholl	..	..
,,	Weymouth..........	1·03	26	,,	Coupar Angus........	1·38	35
,,	Ashburton, Druid Ho.	·95	24	,,	Montrose Asylum	·56	14
,,	Cullompton	·97	25	XVII.	Logie Coldstone, School	1·42	36
,,	Hartland Abbey	1·65	42	,,	Fyvie Castle..........	1·80	46
,,	Penzance, Morrab Gden.	1·49	38	,,	Grantown-on-Spey ...	1·54	39
,,	St. Austell, Trevarna.	1·65	42	XVIII.	Kingussie, Fasnakyle..	2·93	74
,,	Crewkerne Merefield Ho	·54	14	,,	Fort Augustus........	4·72	120
VI.	Clifton College	1·18	30	,,	Loch Quoich, Loan ...	..	..
,,	Ledbury, Underdown.	·95	24	,,	Fortrose	2·18	55
,,	Shifnal, Hatton Grange	1·08	27	,,	Faire-na-Squir........	7·18	182
,,	Ashbourne, Mayfield.	·97	25	,,	Skye, Dunvegan	7·32	186
,,	Barnt Green, Upwood	·95	24	XIX.	Loch Carron, Plockton.	6·34	161
,,	Blockley, Upton Wold	·67	17	,,	Dornoch, St. Gilbert's .	2·41	61
VII.	Leicester, Town Hall Sq.	·61	15	,,	Tongue Manse	2·92	74
,,	Grantham, Saltersford	1·27	32	,,	Melvich Schoolhouse ..	2·16	55
,,	Louth, Westgate	·61	15	XX.	Dunmanway Rectory..	3·26	83
,,	Mansfield, West Bank	·93	24	,,	Mitchelstown Castle...	1·75	44
VIII.	Nantwich, Dorfold Hall	·72	18	,,	Gearahameen	5·40	137
,,	Bolton, Queen's Park.	2·28	58	,,	Darrynane Abbey	3·22	82
,,	Lancaster, Strathspey.	2·42	61	,,	Cashel, Ballinamona...	1·31	33
IX.	Wath-upon-Dearne...	·86	22	,,	Roscrea, Timoney Park	1·69	43
,,	Bradford, Lister Park.	1·10	28	,,	Ballybunion..........	2·09	53
,,	West Witton.........	3·16	80	,,	Broadford, Hurdlestown	2·65	67
,,	Scarborough, Scalby..	·92	23	XXI.	Kilkenny Castle.......	1·06	27
,,	Middlesbro', Albert Pk.	1·55	39	,,	Rathnew, Clonmannon	1·44	37
,,	Mickleton...........	·90	23	,,	Hacketstown Rectory .	1·58	40
X.	Bellingham	1·39	35	,,	Balbriggan, Ardgillan .	·82	21
,,	Ilderton, Lilburn	·82	21	,,	Drogheda	1·21	31
,,	Orton...............	3·03	77	,,	Athlone, Twyford	2·21	56
XI.	Llanfrechfa Grange ..	1·13	29	XXII.	Castle Forbes Gdns....	2·43	62
,,	Treherbert, Tyn-y-waun	2·33	59	,,	Ballynahinch Castle...	3·61	92
,,	Carmarthen Friary ..	1·96	50	,,	Galway, Grammar Sch.	3·03	77
,,	Lampeter, Falcondale	1·67	42	XXIII.	Westport House	1·79	45
,,	Cray Station	2·00	51	,,	Enniskillen, Portora...	1·67	42
,,	B'ham W.W., Tyrmyndd	1·19	30	,,	Armagh Observatory ..	1·77	45
,,	Lake Vyrnwy.......	..	..	,,	Warrenpoint	1·71	43
,,	Llangynhafal, P. Drâw	·67	17	,,	Belfast, Cave Hill Rd..	1·92	49
,,	Oakley Quarries	4·49	114	,,	Glenarm Castle	2·08	53
,,	Dolgelly, Bryntirion..	1·84	47	,,	Londonderry, Creggan.	2·02	51
,,	Snowdon, L. Llydaw.	6·65	69	,,	Sion Mills............	1·72	44
,,	Lligwy	1·16	29	,,	Milford, The Manse ...	1·32	33
XII.	Stoneykirk, Ardwell Ho.	2·52	64	,,	Narin, Kiltoorish	1·60	41
,,	Carsphairn, Shiel.....	3·98	101	,,	Killybegs, Rockmount .	2·89	73

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° F.
London, Kew Observatory	1018·5	+4·6	57	28	30	5	49·5	39·7	44·6	+4·3
Gibraltar	1022·9	+3·3	67	5, 12, 31	44	21	62·3	49·2	55·8	−0·9
Malta	1015·4	−0·5	69	3	47	14	59·8	53·2	56·5	−0·7
Sierra Leone	1011·6	+0·5	92	20	70	30, 31	87·4	74·5	80·9	−0·6
Lagos, Nigeria	1012·5	+2·0	89	5	71	7	86·8	75·5	81·1	−0·2
Kaduna, Nigeria	..	..	..	..	..	..	..	..	..	..
Zomba, Nyasaland	1007·8	−0·8	87	3	62	4, 19	80·3	64·9	72·6	−0·1
Salisbury, Rhodesia	1006·7	−3·2	91	20	50	20	83·5	55·2	69·4	−0·5
Cape Town	1013·6	−0·7	87	25	55	12	76·8	59·5	68·1	+0·5
Johannesburg	1010·1	−0·6	84	18	45	14	75·0	53·9	64·5	−0·6
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	..	..	90	4	48	29	80·2	56·4	68·3	−3·5
Calcutta, Alipore Obsy.	1015·5	−0·2	83	31	53	13, 29	79·3	57·1	68·2	+1·7
Bombay	1013·2	−0·1	89	10	67	30	85·2	70·7	77·9	+0·6
Madras	1014·1	+0·5	86	2	64	22	84·2	69·4	76·8	+0·3
Colombo, Ceylon	1010·5	+0·7	92	13	71	17	88·2	72·8	80·5	+0·8
Hong Kong	1019·4	−0·5	76	17	54	23	69·3	61·3	65·3	+2·4
Sandakan	..	..	89	3, 5, 15	73	17	86·1	74·7	80·4	+0·3
Sydney	1011·8	−0·1	90	13	58	8	75·3	63·4	69·3	−0·7
Melbourne	1013·6	+1·3	87	12	46	7	71·6	56·0	63·8	−0·9
Adelaide	..	..	..	..	..	..	..	..	..	..
Perth, Western Australia	1011·7	−1·6	102	17	50	1	84·6	63·6	74·1	+3·4
Coolgardie	1012·0	+0·8	104	19	43	1	88·1	60·9	74·5	−1·3
Brisbane	1010·9	−0·9	96	6	61	11	83·6	67·5	75·5	−0·8
Hobart, Tasmania	1013·0	+3·3	76	25	43	28	65·4	50·9	58·1	−2·3
Wellington, N.Z.	1014·7	+2·6	80	10	42	14	66·2	53·2	59·7	−0·8
Suva, Fiji	1009·4	+0·8	88	24	69	9, 11	84·8	70·8	77·8	−1·1
Kingston, Jamaica	1014·3	+0·1	90	9	66	31	86·6	69·2	77·9	+0·2
Grenada, W.I.	1012·1	+0·2	86	2, 4, 8	70	25, 26	83·1	73·4	78·3	+0·2
Toronto	1015·8	−1·6	52	2	0	22	35·4	21·3	28·3	+2·1
Winnipeg	1018·2	+0·3	37	10	−26	23	20·0	2·9	11·5	+5·8
St. John, N.B.	1011·3	−2·9	52	18	− 5	22	32·1	16·3	24·2	−0·2
Victoria, B.C.	1020·1	+3·3	56	10	16	19	41·7	33·9	37·8	−3·7

London, Kew Observatory.—Mean speed of wind 9·8 mi/hr ; 5 days with fog. June corrected values for rainfall 0·20, 5, −50.

Gibraltar.—1 day with thunder heard, 1 day with gale.

Malta.—Prevailing wind direction N.W. 2 days with hail, 2 days with thunder heard, 1 day with snow.

Sierra Leone.—Calms predominate. 3 days with thunder heard, 10 days with harmattan.

Colombo, Ceylon.—Prevailing wind direction N, mean speed 6·9 mi/hr.

London, Kew Observatory :—										
Corrected values Oct.1921	..	..	82	5	35	25	66·2	46·9	56·6	+6·7
Corrected values Nov.1921	..	..	58	1, 4	24	10	45·7	35·8	40·8	−3·2
Grenada, W.I., Jan. 1921	1014·0	+1·2	87	1, 23	69	17	82·8	72·7	77·7	+0·7
,, Feb. 1921	1013·8	+0·4	86	16, 21	70	2, 4	82·5	72·4	77·5	+0·5

Grenada.—Prevailing wind direction, Jan. E, Feb. E.

British Empire, December 1921.

TEMPERATURE		Relative Humidity	Mean Cloud Am'nt	PRECIPITATION				BRIGHT SUNSHINE		STATIONS
Mean Wet Bulb. °F.	Absolute Min. on Grass °F.	°/o	0–10	Amount in.	Amount mm.	Diff. from Normal mm.	Days	Hours per day	Percentage of possible	
43·0	23	83	7·5	1·30	33	− 25	13	1·2	15	London, Kew Observatory
51·7	35	78	2·8	3·33	85	− 55	8	..	..	Gibraltar.
51·6	42	75	5·9	3·45	88	+ 2	13	4·7	48	Malta.
75·1	..	73	3·7	2·16	55	+ 17	3	..	..	Sierra Leone.
76·1	67	87	8·7	2·35	60	+ 39	6	..	..	Lagos, Nigeria.
..	..	..	..	..	..	..	..	..	..	Kaduna, Nigeria.
..	..	87	8·3	11·00	279	− 12	23	..	..	Zomba, Nyasaland.
66·0	..	69	..	5·24	133	− 13	14	..	..	Salisbury, Rhodesia.
62·4	..	59	3·8	0·76	19	− 3	7	..	..	Cape Town.
56·7	44	69	4·9	6·67	169	+ 46	15	8·5	62	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
58·0	..	54	4·1	2·96	75	+ 13	9	..	..	Bloemfontein.
63·6	43	51	2·3	0·00	0	− 5	0*	..	..	Calcutta, Alipore Obsy.
69·3	57	62	0·9	0·00	0	− 2	0*	..	..	Bombay.
70·5	59	75	5·4	2·04	52	−106	7*	4·8	..	Madras.
75·0	67	67	6·2	3·96	101	− 39	10	..	..	Colombo, Ceylon.
58·8	..	70	6·4	0·22	6	− 25	5	5·3	49	Hong Kong.
77·3	..	88	..	31·12	790	+341	21	..	..	Sandakan.
64·7	45	70	7·5	5·28	134	+ 67	14	5·2	36	Sydney.
58·9	38	67	6·6	2·49	63	+ 4	14	..	..	Melbourne.
..	..	..	..	..	..	..	..	..	..	Adelaide.
65·2	45	54	3·7	0·78	20	+ 5	5	9·5	..	Perth, Western Australia.
61·9	..	37	5·1	1·16	29	+ 11	8	..	..	Coolgardie.
69·8	56	66	6·0	11·33	288	+160	14	..	..	Brisbane.
52·0	36	64	7·7	0·58	15	− 35	11	5·9	39	Hobart, Tasmania.
54·8	31	72	6·4	6·67	169	+ 87	15	6·6	44	Wellington, N.Z.
76·6	..	79	6·6	29·40	747	+439	23	..	..	Suva, Fiji.
..	..	74	5·2	1·17	30	− 11	5	..	..	Kingston, Jamaica.
73·7	..	77	4·1	10·18	259	+ 71	25	..	..	Grenada, W.I.
24·9	0	63	8·1	2·40	61	− 11	17	..	..	Toronto.
10·4	..	90	5·1	0·50	13	− 11	8	..	..	Winnipeg.
20·8	5	61	5·0	3·02	77	− 29	14	..	..	St. John, N.B.
35·3	15	83	6·8	5·57	141	− 9	14	..	..	Victoria, B.C.

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

HONG KONG.—Prevailing wind direction E, mean speed 11·6 mi/hr.

SANDAKAN.—Nov., mean wet bulb 77·6°, relative humidity 84 per cent.

MELBOURNE.—Coldest December for 6 years. Feb. rel. humidity for 85 per cent. read 47 per cent.

SUVA, FIJI.—4 days with thunder heard.

GRENADA, W.I.—Prevailing wind direction E., 2 days with thunder heard.

										LONDON, KEW OBSERVATORY :—
53·4	..	78	..	..	..	..	..	..	..	Corrected values Oct. 1921
38·9	..	84	..	..	..	..	..	..	..	Corrected values Nov 1921
71·9	..	73	3·7	2·86	73	− 40	13	..	..	GRENADA, W.I., Jan. 1921
71·7	..	73	3·7	2·37	60	− 12	19	..	..	„ Feb. 1921

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean of Day M.S.L. mb.	Diff. from Normal mb.	Max. °F.	Date	Min. °F.	Date	Max. °F.	Min. °F.	½ max. and min. °F.	Diff. from Normal °F.
London, Kew Obsy..	1019·0	+3·0	89	July 10	24	Nov. 10	60·2	44·8	52·5	+2·8
Gibraltar..........	1018·0	+1·5	91	Aug. 3	42	Jan. 15, 16 Feb. 8	70·2	57·6	63·9	−0.2
Malta............	1016·0	+1·2	99	July 20	44	Feb. 2	69·9	60·8	65·3	+0·1
Sierra Leone,......	1011·8	0·0	97	Feb. 17	64	July 8	87·4	72·1	79·7	−1·2
Lagos, Nigeria	1012·5	+1·1	99	Apr. 16 May 4	60	Mar. 16	86·1	75·2	80·7	+0·5
Kaduna, Nigeria .	..	..	..	..	..	..	..	..	..	..
Zomba, Nyasaland .	1012·4	+0·3	97	Nov. 12	45	Aug. 5	78·6	60·4	69·5	+0·4
Salisbury, Rhodesia	1012·5	−1·6	99	Nov. 10	35	Aug. 1	78·8	52·6	65·7	+0·4
Cape Town........	1016·9	−0·1	100	Feb. 24	35	July 20	71·2	54·0	62·6	+0·5
Johannesburg	1016·6	0·0	89	Jan. 21	26	Aug. 10	68·9	48·9	58·9	−0·6
Mauritius.........	..	..	..	..	..	..	..	..	..	.
Bloemfontein......	..	..	95	Jan. 26	16	July 2	73·3	46·8	60·1	−1·3
Calcutta, Alipore Obsy.	1007·0	−0·5	102	Mar. 23 May 24	49	Jan. 4	87·5	71·6	79·6	+0·9
Bombay	1008·5	−0·6	96	Feb. 16 Apr. 29	61	Jan. 22	86·9	75·3	81·1	+0·6
Madras	1008.5	−0·3	111	May 25	64	Nov. 10	91·1	75·1	83·1	+0·2
Colombo, Ceylon...	1009·9	+0·5	93	Feb. 11	65	Mar. 2	87·3	75·3	81·3	+0·1
Hong Kong	1012·8	+0·2	92	Aug. 22	44	Feb. 4	77·1	68·5	72·8	+0·5
Sandakan.........	..	..	92	May 14 Aug. 16, 18	71	Sept. 13	87·0	75·0	81·0	−0·3
Sydney	1017·2	+1·3	99	Mar. 25	40	Aug. 6	72·0	56·7	64·4	+1·4
Melbourne.........	1017·1	+1·0	107	Jan. 24	33	June 27. July 23	68·2	51·1	59·7	+1·3
Adelaide	..	..	..	..	..	..	..	..	..	..
Perth, W. Australia.	1015·6	−0·8	108	Jan. 28	40	June 29	75·1	57·0	66·1	+2·1
Coolgardie	1015·5	−0·5	112	Jan. 21	30	July 29	78·7	53·1	65·9	+1·4
Brisbane..........	1016·9	+1·2	96	Dec. 6	42	Aug. 6	77·2	60·8	69·0	+0·1
Hobart, Tasmania..	1013·9	+1·4	96	Jan. 1, Nov. 17	32	July 31 Aug. 1,19	63·2	47·7	55·5	+1.2
Wellington, N.Z....	1016·0	+1·9	82	Jan. 2	30	July 11	61·4	48·9	55·2	−0·2
Suva, Fiji.........	1011·9	+0·5	91	Mar. 19	58	July 14	84.9	69·0	76·9	−0·1
Kingston, Jamaica..	1014·1	+0·2	93	sev. months.	66	Jan. Mar. Dec.	87·7	71·1	79·4	+0·1
Grenada, W.I.	1012·2	−0·2	93	Sept. 7	68	Mar. 11	84·1	73·7	78·9	+0·2
Toronto...........	1016·7	+0·3	98	July 5	−5	Jan. 18	59·0	41·3	50·1	+5·7
Winnipeg.........	1015·4	−0·8	94	June, July, Aug.	−33	Jan. 17	48·3	28·5	38·4	+4·1
St. John, N.B......	1015·3	+0·6	87	Sept. 3	−5	Jan. Feb. Dec.	50·3	34·7	42·5	+1·3
Victoria, B.C.......	1016·9	+0·5	77	July 22	16	Dec. 19	54·3	42·9	48·6	−0·9

LONDON, KEW OBSERVATORY.—Mean speed of wind 7·5 mi/hr. ; 4 days with snow, 5 days with hail, 15 days with thunder heard, 65 days with fog.

GIBRALTAR.—4 days with hail, 16 days with thunder heard, 6 days with fog, 11 days with gale. Mean max. and min. temps. refer to 24-hr. period.

MALTA.—Prevailing wind direction north-westerly. Mean max. and min. temps. refer to 24-hr. period.

SIERRA LEONE.—Prevailing wind direction SW. ; 50 days with thunder heard, 3 days with gale.

SALISBURY.—1 day with thunder heard.

Mauritius :—										
May 1921	1014·4	−2·0	80	4, 22	55	26	77·0	64·4	70·7	−1·9
June	1017·9	−1·1	77	1	54	26	75·0	60·4	67·7	−1·7
July............	1019·3	−1·1	77	27, 31	55	22	74·7	61·7	68·2	−0·1

Mauritius :—May. Prevailing wind direction ESE., mean speed 6·5 mi/hr.
June. Prevailing with direction ESE., mean speed 6·9 mi/hr.
July. Prevailing wind direction ESE., mean speed 9·4 mi/hr.

British Empire, Year 1921.

TEMPERATURE Mean Wet Bulb. °F.	TEMPERATURE Absolute Min. on Grass °F.	Relative Humidity %	Mean Cloud Am'nt 0–10	PRECIPITATION Amount in.	PRECIPITATION Amount mm.	PRECIPITATION Diff. from Normal mm.	PRECIPITATION Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible	STATIONS
49·1	16	73	6·3	12·14	309	− 297	104	4·6	37	London, Kew Obsy.
59·9	33	79	4·0	38·89	988	+ 78	74	..	..	Gibraltar.
..	..	..	(4·4)	18·81	478	+ 16	87	7·7	62	Malta.
74·9	..	73	5·3	134·17	3408	− 533	156	..	..	Sierra Leone.
76·9	52	84	8·0	83·22	2114	+ 294	149	..	..	Lagos, Nigeria.
..	..	..	..	..	..	..	..	..	..	Kaduna, Nigeria.
..	..	84	5·3	59·38	1508	+ 97	135	..	..	Zomba, Nyasaland.
58·3	? 28	60	4·4	37·29	947	+ 139	91	..	..	Salisbury, Rhodesia.
57·7	..	66	4·5	25·83	656	+ 7	101	..	..	Cape Town.
49·5	25	64	3·8	31·75	806	+ 6	96	8·4	71	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
50·2	..	63	3·3	21·85	555	− 40	73	..	..	Bloemfontein.
74·2	39	61	4·5	56·56	1437	− 131	*78	..	..	Calcutta, Alipore Obsy.
74·1	49	69	3·4	86·02	2185	+ 359	*101	..	..	Bombay.
75·0	59	72	4·7	54·43	1383	+ 128	*96	6·0	..	Madras.
77·1	55	70	7·1	53·56	1360	− 796	179	..	..	Colombo, Ceylon.
67·1	..	75	6·5	97·35	2473	+ 360	128	6·1	50	Hong Kong.
76·6	..	83	..	165·07	4193	+1145	186	..	..	Sandakan.
59·9	30	69	4·9	43·34	1101	− 118	140	6·4	54	Sydney.
54·8	30	66	5·7	29·76	756	+ 108	144	..	..	Melbourne.
..	..	..	..	..	..	..	..	..	..	Adelaide.
59·8	30	62	4·5	41·09	1044	+ 191	135	..	..	Perth, W. Australia.
57·3	25	44	3·9	11·84	301	+ 43	58	..	..	Coolgardie.
64·2	31	69	5·1	54·26	1378	+ 199	160	..	..	Brisbane.
49·7	23	65	6·2	18·04	458	− 144	159	..	..	Hobart, Tasmania.
51·8	21	75	6·5	42·86	1089	− 143	157	5·7	46	Wellington, N.Z.
74·7	..	88	..	170·66	4335	+1481	231	..	..	Suva Fiji.
..	..	74	6·0	25·91	658	− 203	103	..	..	Kingston, Jamaica.
74·2	..	75	4·3	78·62	1997	+ 70	241	..	..	Grenada, W.I.
44·4	− 9	73	5·0	27·35	695	− 155	148	..	..	Toronto.
35·4	..	81	4·9	22·03	560	+ 43	118	..	..	Winnipeg.
38·8	− 6	75	5·8	38·69	983	− 237	145	..	..	St. John, N.B.
44·9	15	81	6·0	35·10	892	+ 65	164	..	..	Victoria, B.C.

* For Indian Stations a rain day is a day on which 0·1-in. (2·5 mm.) or more rain has fallen.

COLOMBO, CEYLON.—Prevailing wind direction WSW. ; mean speed 5·6 mi/hr. ; 30 days with thunder heard.

HONG KONG.—Prevailing wind direction easterly ; mean speed 10·6 mi/hr. ; 46 days with thunder heard, 5 days with fog.

WELLINGTON.—5 days with hail, 2 days with thunder heard, 1 day with fog.

SUVA, FIJI.—32 days with thunder heard.

GRENADA.—10 days with thunder heard, 1 day with gale.

										Mauritius :—
66·6	47	81	6·0	3·91	99	+ 22	21	5·5	49	May 1921.
62·6	47	74	4·7	0·58	15	− 56	9	7·9	72	June.
62·8	49	74	4·9	0·85	22	− 41	16	7·1	64	July.

(*Continued from p.* 141.)

and north-west of Madrid than there was in December, and ski-ing was still being enjoyed. The winter sports season has lasted for five months.

A message from Cairo dated May 3rd stated that the low level of the Nile was causing much anxiety, notably with regard to the cotton crop. The supply from the White Nile, which provides the bulk of the summer water, has disappointed expectations, being much lower than in any year hitherto recorded. The Blue Nile was also very low.

On the 10th an area of 50 square miles to the west of Winnipeg was in a flooded state owing to the rise of the Assiniboine River. The average depth of water was four feet and a large acreage of the finest wheatlands was threatened. The floods were aggravated by further heavy rains, but were stationary on the 15th, since when no information has been received.

A bridge over the Brazos River, Texas, U.S.A., collapsed on the 16th owing to floods. Of thirty persons on the bridge, only six were rescued.

Further heavy rains, which were much needed, fell in South Australia early in the month.

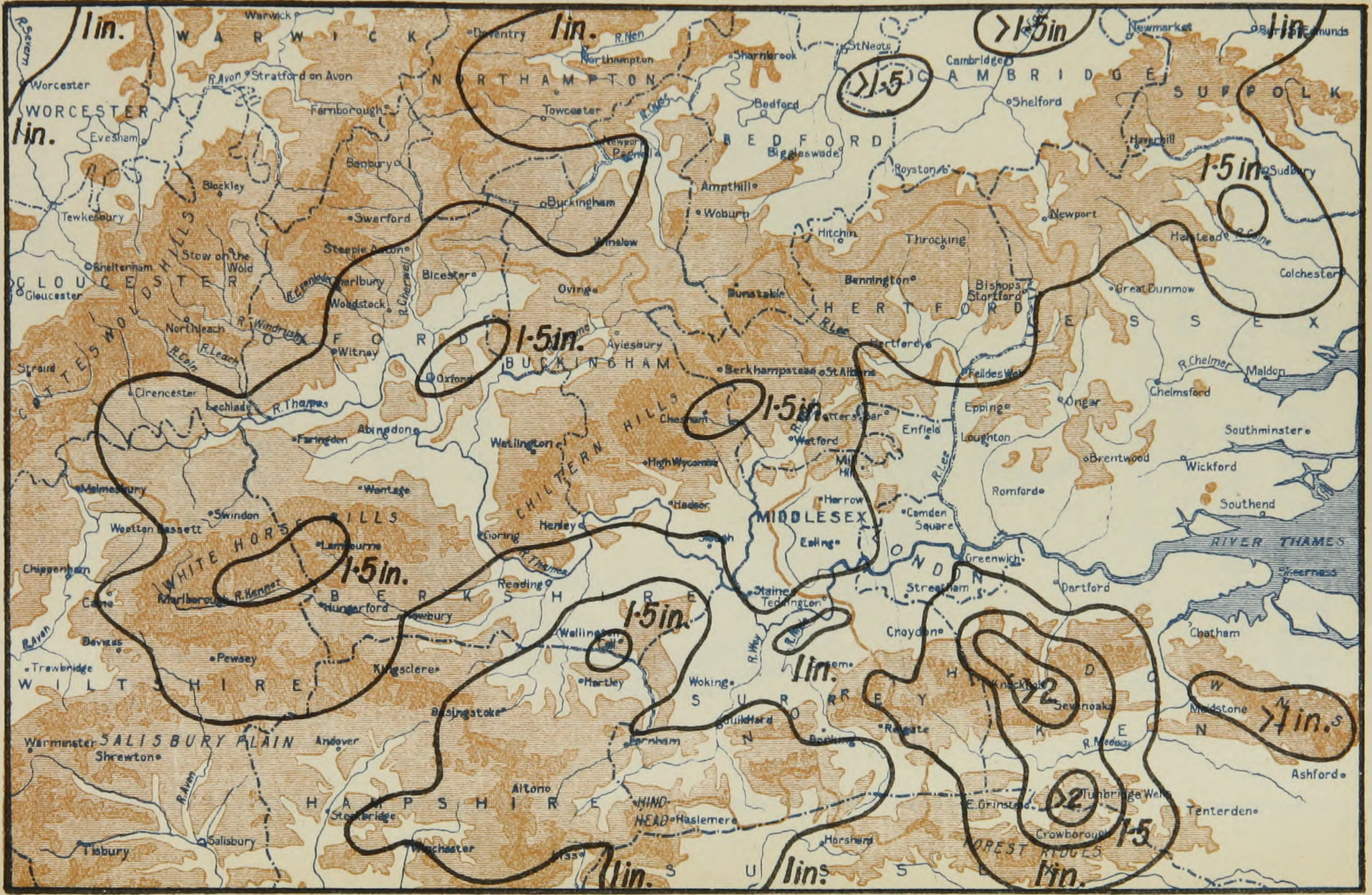
The special message from Brazil states that the general rainfall during the month was 180 mm. In the north the fall was above normal, the excess at many stations being more than 150 mm. In the centre of the country the rainfall was 20 mm. below normal, and in the south it was irregular or scarce, the general deficit being 22 mm. Sunshine was slightly below normal; the other elements present nothing unusual. The excessive rains in the north were harmful to the sugar cane plantations, but the weather was favourable to the coffee crop. There were slight frosts only in the extreme south, Five anticyclones swept over the southern part of the country, but there was no abnormal cold. At Rio de Janeiro the average pressure was ·08 mb. above normal, and the average temperature 0·9° F. above normal.

The rainfall of the month varied over the British Isles to a greater extent than is usually the case. At Marchmont in Berwickshire only about one-quarter of the average rainfall was recorded, while at Fort William as much as three times the average occurred. Rainfall above the average occurred mainly in the western half of Scotland, where a considerable area in the Western Highlands received more than twice the average, and in isolated areas in the west of Ireland. Along the south coast and in the centre of England, along the east coast of Scotland, and in the neighbourhood of Dublin, less than half the average for the month was recorded. The actual rainfall in these areas amounted for the most part to less than 25 mm. (1 in.). In the West of Scotland falls of 250 mm. (10 in.) were widespread. The thunderstorms towards the end of the month were accompanied in places by hailstones of a remarkable size. (*See* pp. 129 to 131.)

The general rainfall for May, expressed as a percentage of the average, was: England and Wales, 57; Scotland, 129; Ireland, 69; British Isles, 84.

In London, Camden Square, the mean temperature was 59·2° F., or 4·7° F. above the average; the duration of rainfall, 12·9 hours; and the evaporation, 2·93 inch.

THAMES VALLEY RAINFALL —— MAY, 1922.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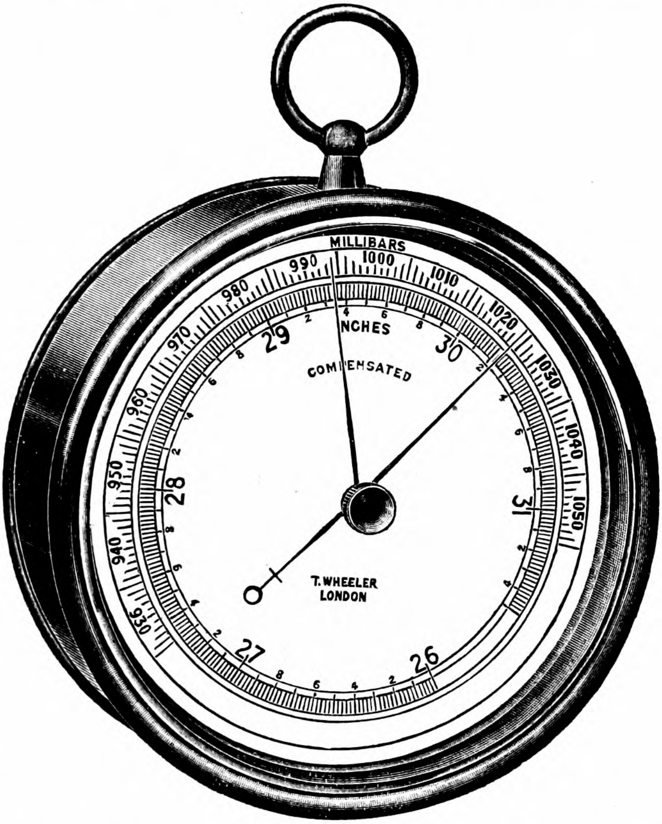
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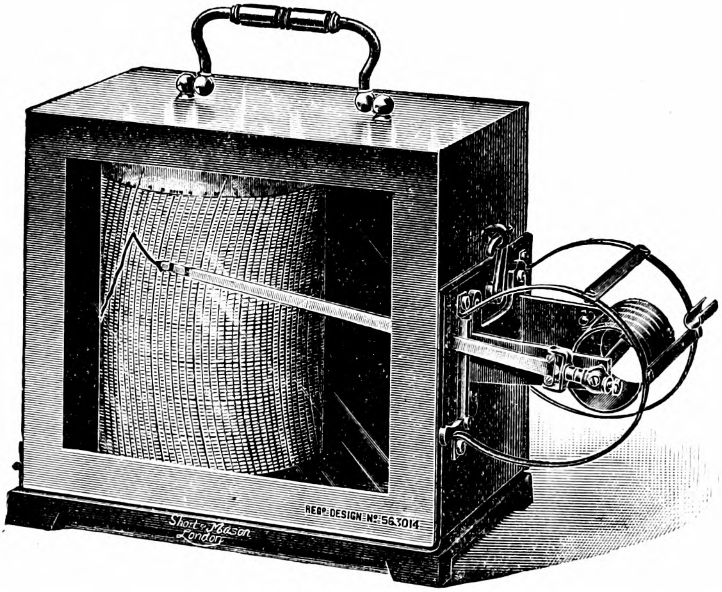

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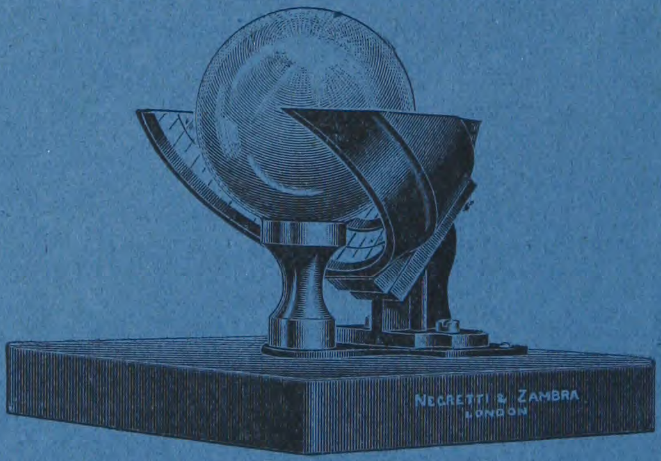

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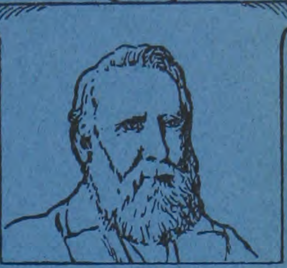

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JULY 1922
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The responsibility for all facts and opinions expressed in the signed articles and letters published in this Magazine rests with their respective authors.

JULY 1922.

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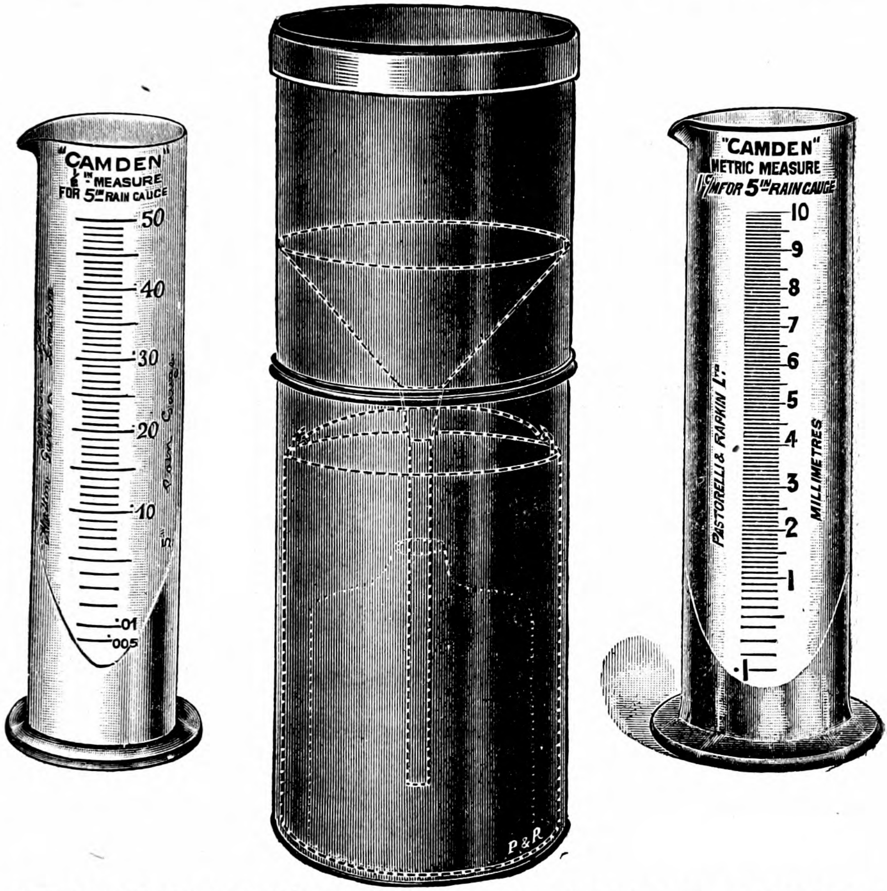
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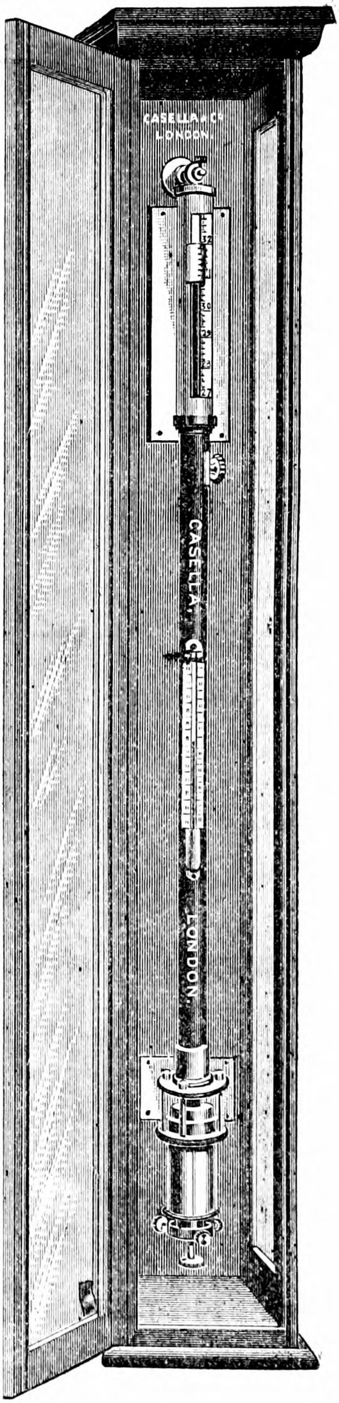
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The Study of Weather and Crops.

By Sir Daniel Hall, K.C.B., LL.D., F.R.S.

MR. HOOKER'S papers open up a field of investigation which may become of cardinal importance to agriculture. We may define the method as the correlation of crop production with the previous meteorological data, the ultimate object as the prediction of the yields to be expected from a consideration of the weather conditions prevailing. Of course the question is beset with difficulties, and in consequence it must for some time to come remain entirely within the region of investigation and research.

The main difficulties arise from the imperfection of the data that are available for the purpose. In the first place, the yield of a crop represents the resultant of many factors, any one of which may have been the limiting factor at work. The foundations of a crop may be solidly laid, growth may proceed satisfactorily all through the critical season, yet the produce may be curtailed and all predictions falsified by the weather in the final stages. Sir Napier Shaw's prediction of the yield of wheat from the rainfall of the previous autumn holds good in five seasons out of six, in the sixth some other factor has had an overpowering influence. Studying the growth of the wheat plant we can distinguish three well-marked stages—the autumn and early winter during which the root system is being built up, the growing period, and, finally, the migration period, when the

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total material in the plant increases but little, but when the previously assimilated material is moved from roots, stem and leaves into the seed. During the first period a comparatively dry soil is essential, for the development of the root system is very dependent upon aeration; moreover, in a dry soil the roots are encouraged to extend in search of moisture. Given a deep and well-developed root-system the wheat plant becomes less dependent upon the immediate rainfall during the growing period, since it is drawing water from a thicker layer of soil at a greater depth, and therefore less exposed to evaporation. (This independence of the wheat plant to supplies of rain during the May-June period was well illustrated by the growth of wheat during 1921.) Growth and assimilation—the building-up of carbohydrates from the carbon dioxide of the atmosphere, are now the main functions of the plant, and the rate of action is, in the main, determined by temperature. By the time the flowering period is reached the wheat plant has to a large extent ceased to elaborate fresh material, the leaves are ageing and gradually begin to yellow off and die. After fertilisation the transfer begins of ready formed material in the plant to the seed, and the amount of grain produced depends upon this latter process. The " yield " in any season depends not only upon the growth, but upon the extent to which migration is accomplished. The latter factor may be approximately measured by the ratio of grain to straw, which, for example, varied from 60 : 100 in 1863 to 42 : 100 in 1852 on one of the completely manured plots at Rothamsted. In other words, 37 per cent. of the material grown became " grain " in 1863, whereas less than 30 per cent.became grain in 1852.

Of course there is also the possibility of a loss of crop by bad weather during the actual harvest; but, in practice, this is rarely a large factor, the quality may be injured, but the grain gets weighed.

Thus the final yield is determined by the cumulative effects of three, if not four, independent periods in the life-history of the plant, each probably requiring a different type of weather; nor will it be an easy matter to ascertain the relative part contributed by each to the final resultant. Again, this yield is never a simple resultant of various forces: there is always an element of compound interest about growth; if, for example, at an early stage the conditions are favourable to a good development of leaf, there is then more active material to take advantage of a further spell of good weather.

There are, again, imperfections in the meteorological data. In the main, only rainfall and temperature (mean or accumulated) have been considered. Even rainfall may be a deceptive figure, what is really of moment is the supply of water to the roots, and this may be independent of the actual rainfall during the period under review. The effect of rain, again, cannot be a linear function, positive or negative; there must be an optimum condition and a falling off with excess in either direction. We have also to recognise the importance of humidity and illumination; in fact, we have, as yet, no means of defining, meteorologically, what every farmer recognises as growing weather.

Further investigation, then, is needed and, this may take place along two directions. We may have work on broad lines, similar to that of Mr. Hooker and Sir Napier Shaw, in which it is sought to establish correlations between the average crop yields of a country or similar area using the meteorological data usually available, or we may have intensive work which attempts to correlate the yield of a particular plot with a more searching examination of the weather it actually experiences. In the first case, the investigator is further handicapped by the fact that the crop yields, upon which he depends, are only estimates, and therefore subject to a large margin of error; in particular, the extremes, whether of high yield or low, tend to be underestimated.

Probably the second form of investigation is the more promising at the present time, because, until we can disengage the periods in the life-history of the plant, and assign some causal connection between the weather conditions prevailing and the progress of the crop at that period, we are without guidance in looking for the larger correlations. The problem would have to be simplified and reduced to its elements as much as possible. For example, a not unpromising field for investigation would be to examine the factors making for vegetative growth. The index might be the daily elongation of some plant like the hop with a single shoot, or the amount of grass or clover that resulted from a daily standardised cutting. Suitable arrangements could be made whereby the rainfall (or water supply in the soil), temperature and illumination factors could be made separately operative; of course, the factor depending upon the age of the experimental plant would also have to be distinguished. It would be an advance, even if daily observations of plant growth and weather data could be correlated so as to arrive at a definition of "growing weather."

But it would be idle to attempt to lay down the course of the investigation. Enough, perhaps, has been said to show that there exists a very promising field for research from either the meteorological or the plant physiological side; success is most probable if workers of each type will collaborate.

Aberdeen and Benson.

THE past month is remarkable for the announcement of two retirements : that of Professor Charles Niven, F.R.S., from the Professorship of Natural Philosophy at Aberdeen, to which was attached the care (on behalf of the Meteorological Office) of the Meteorological Observatory at King's College; and that of Mr. W. H. Dines, F.R.S., from the direction and management of the Aerological Observatory at Benson.

The Observatory at Aberdeen is the last example of the policy of the Meteorological Committee of 1867 to create meteorological observatories as subsidised adjuncts to institutions maintained by other bodies for scientific work. Kew, Glasgow, Stonyhurst, Armagh, Falmouth were all at one time on a similar footing. Professor Niven lent himself with great cordiality to any development of the work in his charge, Mr. G. A. Clarke was encouraged in his studies of clouds and the observatory was the earliest to follow Mr. Cave's lead in "pilot-ballooning" as a regular means of observation. Professor Niven, one of many distinguished brothers, was Senior Wrangler in his year at Cambridge and a prominent mathematical physicist for whom the New Physical Laboratory at Mareschal College was constituted and the observatory could always rely upon him for most efficient help.

Mr. W. H. Dines is also a link with the past. Devoted to the study of meteorology as a family tradition and endowed with all the qualifications that are implied by a training in mechanical engineering, a Wrangler's degree at Cambridge, long experience in teaching of mathematics, the habit of mind which sees what is there, no more and no less, and a personal knowledge of the ways of meteorology and meteorologists in society, he was exactly qualified to undertake the direction and management of an observatory for the upper air, and after some experience with kites at Oxshott, he took on charge the work on the Upper Air for the Meteorological Office in return for out-of-pocket expenses and a small honorarium, which was not large enough to interfere with his sense of freedom. He chose where he would live with a view to his observations; first at Pyrton Hill, where kites might be flown without undue anxiety, and next at Benson.

It was one of the first expansions of the work of the Office provided by the economies effected by the reorganisation of 1905. It has been successful beyond hope and expectation, though both were high. In the show cases at South Kensington are two glass models of the temperature distribution in the atmosphere for July 27th and 29th, 1908. They represent the high-water mark of the investigation of the upper air in this country, unless the title be reserved for the launching of 25 balloons in 24 hours from Manchester on two occasions—June 2–3, 1909 and March 18–19, 1910, and to this day no other country can show the like of them.

The instruments, the methods of handling, the calibration, the reduction, are all due to Mr. Dines, and the instruments which he constructed have provided, in the competent hands of Mr. W. Patterson, an excellent account of the upper air of Canada. They have also made a beginning with the investigation of the upper air of Australia, perhaps at the moment the most necessary of all meteorological work.

Mr. Dines's summary in the *Characteristics of the Free Atmosphere** is remarkable evidence of personal achievement. Reference was constantly made to the facts and summaries given therein during the development of aircraft and engines. An appreciation of Mr. Dines's services to science and the State might very well be expressed otherwise, but he has at least the satisfaction of knowing that if the achievement of the maximum result with the minimum of cost is to be regarded as good service none is better than his.

Mr. Dines began with the study of wind, went on to the upper air, and at the end of his official service finds himself embroiled in radiation. With his unwillingness to accept what he cannot verify he is still busy with the distribution of temperature in the atmosphere. If he will recall what a crazy patchwork the science of Meteorology was acknowledged to be when he began his active share in it in the " seventies," and how much he has contributed to making it a tissue with a pattern in it he cannot fail to find encouragement to pursue this study of radiation in his retirement, with the assurance that the interest which those who look on take in his work increases and will increase with his increasing years.

NAPIER SHAW.

OFFICIAL NOTICE.

THE retirement of Mr. W. H. Dines, F.R.S., Assistant Director in charge of the Meteorological Office, Benson, Oxfordshire, is announced as from June 30th, 1922. The aerological work at Benson will be carried on by Mr. L. H. G. Dines. Mr. C. D. Stewart is appointed to Valencia Observatory in place of Mr. L. H. G. Dines.

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* *Geophysical Memoirs, No.* 13. M.O. 220c, 1919.

The Royal Meteorological Society.

THE usual monthly meeting of this Society was held on Wednesday, June 21st, at 49 Cromwell Road, South Kensington, Dr. C. Chree, F.R.S., President, in the chair

Messrs. J. E. Clark, H. B. Adames and I. D. Margary.—Report on the Phenological Observations in the British Isles for the year 1921.

Since the Royal Meteorological Society gave up the collection of meteorological observations its most important contribution to climatology has been the regular publication of phenological reports. These phenological reports deal with such matters as the time of appearance of flowers, the time of ripening of crops and of the migration of birds.

The year 1921, it will be remembered, was remarkable for the prolonged drought and persistent heat, and the report is therefore of special interest as dealing with the response on the part of plants and animals to the exceptional conditions. The early spring flowers bloomed 18 days before their average dates, but by July the flowering season was only early by six days. Grain cutting was very early. A poor fruit crop is attributed by the investigators to the mildness of the preceding winter and the premature blossoming. Among exceptional effects the following are noted: the frequency of second blossom after the August rains, the early departure of the swallows and the dearth of tortoiseshell and allied butterflies apparently from lack of nettles.

L. F. Richardson, A. Wagner and R. Dietzius.—An Observational Test of the Geostrophic Approximation in the Stratosphere.

The introduction by Sir Napier Shaw of the term "geostrophic wind" for the hypothetical wind which is supposed to blow along the isobars with such a speed that the tendency to a change of direction on account of the rotation of the earth is just balanced by the pressure gradient has done much to simplify the consideration of the complex problems presented by the dynamics of the atmosphere. It is important to remember, however, that in assuming that the actual wind is identical with the "geostrophic wind" we neglect centrifrugal force as well as the acceleration of the air in its direction of motion and the effects of eddy viscosity and of rising and falling currents. The "geostrophic approximation" is this assumption that the actual wind is the same as the geostrophic wind.

One of the reasons why this approximation is so good is that when only a small range of latitude is under consideration the flow of air which is postulated is such that where the isobars are close together the speed is high, where the isobars are far apart the speed is low and there is no tendency for air to accumulate anywhere. If, however, the isobars under consideration extend through many degress of latitude the flow will be comparatively fast in low latitudes, comparatively slow in high latitudes, so that the air will accumulate in the north flowing currents at the expense of the south flowing currents. In his book on *Weather Forecasting by Numerical Process* Mr. Richardson arrived at a formula which expressed one of the results of this law of accumulation of the air in a mathematical form appropriate for certain specified conditions. With the co-operation of Dr. Wagner and Dr. Dietzius he has in the present paper investigated the agreement of the formula with the available observations.

Though the conclusion of this investigation can only be expressed in such terms as " there is probably something in it," the boldness with which the authors have utilised their material is most stimulating. Such work is the justification for the publication by international co-operation of the observations in the upper air.

A SUMMER meeting of the Royal Meteorological Society was held at Croydon Aerodrome on Wednesday, July 5th. The proceedings opened at 3 p.m. with a short address by the Meteorological Officer, Mr. G. R. Hay, who described the arrangements in practice at Croydon for supplying meteorological information to pilots. After the address the company were shown round the aerodrome and arrangements were made for short flights at 5s. a head. Tea was provided at the Trust House. The Society was unfortunate in having a very wet afternoon for its meeting, but in spite of the unfavourable weather a large number of the Fellows and their friends availed themselves of the opportunity afforded of " going up." The arrangements were made by Capt. S. Baker, the Civil Aviation Transport Officer in charge of the aerodrome.

Obituary.

The Prince of Monaco.—The death of Albert I, Prince of Monaco, brings to an end a career not only of a distinguished patron of natural science, but one of real eminence in the scientific world. Although not primarily engaged on meteorological work, his efforts being more especially devoted to biological oceanography, the Prince was keenly interested in climatological research. In 1892 he laid before the Academy of Sciences, at Paris, a project for establishing high and low level meteorological observatories on a large scale, in different parts of the Atlantic Ocean. Stations on the Azores, Madeira, the Canaries, Bermuda and the Peak of Teneriffe were proposed, and it was suggested that Monaco should act as a centre for the collection and distribution of the information obtained. The Prince was an honorary member of the Commission for the Study of the Upper Air and of the Commission for Maritime Meteorology, as well as President of the Section for Physical Oceanography of the International Union for Geodesy and Geophysics. By his invitation the Commission for the Study of the Upper Air met on one occasion at Monaco. By the Prince's generous loan of the Yacht *Princesse Alice* Hergesell was enabled to carry out his valuable investigations of the air over the Oceans.

Adolphus Collenette.—The death of Mr. Adolphus Collenette, in his eighty-first year, following closely upon that of his veteran friend, Dr. Francis Carey, robs the island of Guernsey of another distinguished Meteorologist. Mr. Collenette, whose scientific interests were extremely diverse, spent the whole of his long life in his native island, where he was very widely known and respected. Trained originally to the medical profession, he early adopted the career of a chemist, but from 1880, when he collaborated with the late Dr. Hoskins in studying the climate of Guernsey, meteorology made ever increasing demands on his attention. After the death of Dr. Hoskins in 1888, Mr. Collenette greatly extended the scope of this work. He was appointed director of the States Meteorological Department and, as well as framing local weather forecasts, published an annual report containing rainfall records from all parts of the island and summaries of his own excellent observations. In the last year of his life he was engaged on the organisation of an official observatory designed in order that his work might be carried on after his death, a result which we have every reason to hope will be achieved.

Frederick William Sanderson.—Mr. F. W. Sanderson, Headmaster of Oundle, whose death, from heart failure, occurred suddenly at the conclusion of a lecture which he had been delivering at a Meeting of the National Union of Scientific Workers, was famous as an enthusiastic teacher and organizer. In 30 years he had developed Oundle from a small grammar school into one of the best equipped schools in the Kingdom. He established an efficient climatological station at the school, and observations have been contributed to Meteorological Office publications since 1903.

Correspondence.

To the Editors, "THE METEOROLOGICAL MAGAZINE."

Meteorology and Folk-Lore.—The Rainbow.

METEOROLOGICAL phenomena have always played a large part in human experience. Not least among these has been the arch of phantom colours which has spanned the heavens ever since rain fell and the sun shone.

The Hebrew, as recorded in the Book of Genesis, saw in the bow, which seemed to join heaven and earth, the token of God's covenant with Noah. To the Greek it was saffron-winged Iris, the messenger of Hera, "trailing against the sun her thousand shifting colours" as she darted earthward on some heavenly errand. To the Norseman it was Bifrost, guarded by the watchman Heimdall.

It is probably this latter connection with paganism which gave rise to the Yorkshire custom of "charming away" a rainbow with crossed fingers and a rhyme: and to the belief in Bohemia that not only is it unlucky to walk under a rainbow, but the rain falling through it blights the crops.

A pleasanter belief is the widely spread tradition (found in Sussex among other places) that there is a crock of gold buried at the rainbow's foot. The Bavarians add that to find this gold one must be a Sunday child, and that when found it amounts to three ducats.

The Canadian Indians say the rainbow is the dying breath of the "thunder-bird" slain by the sun, and in Longfellow's "Hiawatha" we find the beautiful idea of the "heaven of flowers."

> "All the wild-flowers of the forest,
> All the lilies of the prairie,
> When on earth they fade and perish,
> Blossom in that heaven above us."

Such are the ways in which man has striven to account for a beautiful optical phenomenon. To-day it has passed from the supernatural to the domain of the most unerring natural laws: yet such knowledge serves only to deepen our wonder, and makes us the more ready to echo the words of one of old:—

> "Look upon the rainbow and praise Him that made it, exceeding beautiful is the brightness thereof. It compasseth the heavens round about with a circle of glory, the hands of the Most High have stretched it." (Eccles. xliii.)

CICELY M. BOTLEY.

10, *Wellington Road, Hastings, May,* 1922.

Weather Lore.

I HAVE yet another " Simple Weather Forecast " to send you, which I find prevails both here in Wiltshire and in Berkshire.

On ploughing the fields in the winter the men come upon numerous burrows made by the longtailed field mouse . . . well stocked against the coming cold weather with grain, beans, etc. The position occupied by the opening of the burrows varies. When it points to the north, the men say we shall have a warm winter; if to the south a cold one is predicted.

Burns, however, who was so well acquainted with everything relating to farm work, says :

" The best laid schemes o' mice an' men
Gang aft agley."

I have no confirmation of the truth of the predictions; we can only wonder at and admire instinct without understanding it.

THEREZA STORY MASKELYNE.

Basset Down, Swindon, Wilts., June 20th, 1922.

Simple Weather Forecasting.

IN the June number of the Magazine, p. 132, Mr. Horner, referring to a " forecast " made by himself and Mr. Robertson in May of last year, adds : " If it was not ' forecasting the drought ' which subsequently eventuated, I do not know what it was." Written, as this was, on April 4th of this year, Mr. Horner was in a position to know exactly what it was, but he has not ventured to disclose his thoughts. Perhaps the following will help readers of the Magazine to attach the appropriate value to it.

At the beginning of last March, Messrs. Horner and Roberston announced in the columns of a Sussex paper what they guessed would be the weather during the whole of the month. The middle of the month brought with it a good illustration of *qui s'excuse s'accuse.* " The dates given in our last forecast, published on March 2nd, have to be brought forward a few days owing to the fact that February being a short month was overlooked, and, therefore, the dates come later than were predicted."

With a persistency deserving of better luck they made yet another attempt to be even with their elusive prey, and on March 30th they made a plunge and asserted that " the present cold weather and unsettled conditions will probably continue until the end of the month, April, however, being ushered in with weather of a far more spring-like character." But from an early hour on the 1st of April Sussex was buried under snow, a gale of bitterly cold wind blowing, this snowstorm was followed by a month of the most wretched April weather since that of 1917. The " forecasts " have been discontinued.

To all who fancy that they, and they only, have discovered the innermost secrets of the future of atmospheric changes, and more particularly of those of the British Isles, it is recommended that they should carefully read and digest the articles on the subject in the *Athenæum* for 1837, p. 561, and 1838, p. 105—they are as true and appropriate to-day as they were in the days of our grandfathers, who were treated to "laborious trifling" by "the Tenterden Steeple" school of logicians.

H.

July 4th, 1922.

The Sun and the Weather.

Is it quite to the point for Dr. Chree to say that I had misunderstood Father Cortie's meaning seeing that he said "intense" and not "disturbed"? I think that it is only proper to assume that a scientific man means what he really says, and I much regret that we should have been at cross purposes.

My contention is that the number of electrons and protons shot out by the sun is probably greater during periods of sunspot activity than at other times. These, or some of them, when they reach the magnetic field of the earth, are directed towards the poles, and heat the upper atmosphere there. They may also be the cause, as many believe, of the aurora and of magnetic storms. If such be the case, a study of the aurora and of magnetic disturbances may yield results of meteorological value.

R. M. DEELEY.

Kew Gardens Road, Kew, June 15th, 1922.

Sunspots and Summer Rainfall.

I WAS very glad to see your *Sunspots and Summer Rainfall* note in the June Meteorological Magazine. Here July and August are totally different from June, which latter is practically as north-easterly as March, April and May, and more due easterly than any of those Spring months except May. From the solstice all is changed—just for two months; north-east wind duration is halved, east is much reduced and our rainfall is greatly increased. August ends this westerly spell and September is very similar to spring.

J. BAXENDELL.

The Fernley Observatory, Southport, June 20th, 1922.

Steaming Roads.

THE condensation of vapour in the air near the ground in the middle of a hot day is not very common. An instance which I observed at Bedford Park, Chiswick, on Sunday, June 25th, 1922, at 10h. G.M.T. should perhaps be placed on record. The morning had been bright and a few minutes before ten there was a very heavy squall. Going out immediately after the rain had stopped and the sun had come out I found mist sweeping over the ground in patches such as one sees over the river on a summer evening. In places the mist was breast high. It was being carried along by the wind at about three miles an hour.

The combination of circumstances seems to have been sufficiently heavy rain very nearly to saturate the air but not sufficient rain to cool the ground and prevent vigorous evaporation.

F. J. W. WHIPPLE.

Bedford Park, Chiswick, July 4th, 1922.

Drought in Herefordshire.

THE drought in this district throughout May and June, 1922, has been considerably worse even that last year. The combined rainfall of these months is only 1·44 ins. (May 0·66, and June ·78) compared with 2·66 ins. last year. The average for May and June is 4·58 ins., so that the actual fall has been only about one quarter. Last year the potatoes were saved by a heavy fall of 1·41 ins. on June 25th; this year we have had no daily fall exceeding ·26 ins. since April. Potato haulm is drying up, the strawberry crop has been practically a failure, and there is less hay and pasture even than last year. Matters would have been still worse had not the period January to April given us 15·31 ins. (4·06 ins. above the average); and though there is on July 1st still an excess of ·92 ins. on the year, this, after a deficit of over 15 in. in 1921, is more apparent than real. In March or early April *The Field* foretold drought conditions starting about mid-April and increasing in May and June, which would be broken by local thunderstorms in the east, but not so much in the west, where the dryness would be more pronounced. This has proved absolutely correct.

R. P. DANSEY.

Kentchurch Rectory, Hereford, July 1st, 1922.

Hailstorm in County Cork.

A SEVERE hailstorm was experienced in the Buttevant-Charleville district of County Cork on February 17th. In the parishes of Churchtown and Ballyhea, situated in the track of the storm, the skylights in the creameries at these places were smashed to pieces. A considerable number of poultry were killed outright and cattle stampeded several miles. The storm, which was of about ten minutes duration, occurred during a lull in a westerly gale. The hailstones were described as being of the size and shape of an ounce plug of tobacco, the largest averaging half an ounce in weight. On melting they disclosed a quantity of black dust, like soot, but more grainy, with a markedly sulphurous smell. The storm traversed an area some 7 miles long, and about 1 mile wide, hail covering the ground to a depth of several inches.

SPENCER RUSSELL.

March 14th, 1922.

NOTES AND QUERIES.

Meteorology at the Royal Agricultural Show, Cambridge. July 4th–8th, 1922.

THE advent of wireless telegraphy has gone far to solve at least two long-standing difficulties of meteorological practice. That meteorology is a co-operative science is a truism. The preparation of a synoptic chart for the purpose of forming an intelligent anticipation of coming weather requires a vast and highly disciplined co-operative organisation. The necessity for collecting telegraphic reports from a large number of observing stations and the consequent costliness of every chart prepared, formed until recently an effective preventative from any attempt at forecasting by a private individual. The forecast room of the Meteorological Office was the only place in England where it was possible to prepare synoptic charts and make forecasts.

Radio telegraphy has profoundly changed all this. When once it had become possible to effect the ordinary international exchange of meteorological data by wireless, it had also become possible for any private individual to pick up the information, prepare his own chart and make his own forecast. Thus the first essential difficulty was swept away.

The other difficulty which has been solved by wireless telegraphy is that of placing the forecasts made by the official organisation before the public without delay. The possibilities of " broadcasting " forecasts have not yet been fully exploited, but it is perfectly obvious that radio-telegraphy provides a complete solution to this long-standing difficulty.

There has recently been a widespread awakening to the possibilities of the new means of communication. It has suddenly been realised that wireless telegraphy need not be confined to highly skilled electricians. Many thousands of amateurs are now picking up messages—amongst them meteorological messages—and wondering what to do with them. A pamphlet* has just been published by the Meteorological Office for the purpose of answering this question, and the Royal Show has provided an excellent opportunity of giving a practical demonstration to that section of the community chiefly interested. The demonstration has been made all the more valuable by the fact that the wireless messages were received by amateur operators, using apparatus of a type within the means of most of the onlookers.

The suggestion that the Office should collaborate in such a demonstration came from Professor T. B. Wood, of the Cambridge University School of Agriculture. To Professor Wood also we have to acknowledge our indebtedness for very valuable assistance in the initial preparations. The wireless apparatus was installed and the reception of the messages was undertaken by Mr. D. R. W. Thompson, assisted by Mr. C. C. A. Hines, both of the University. The data for the British Isles, France, Norway, Sweden, Denmark, Holland, Belgium and Germany were successfully picked up and charts for 7h. and 13h. G.M.T. were prepared each day. Each chart was reproduced on a large blackboard, forecasts for the Cambridge district being written up alongside. The interest taken in the work was such as to justify fully the expectation that the preparation of weather charts will soon become a common adjunct to scientific farming.

The meteorological exhibit also included a complete climatological station, at which the usual routine observations were taken, as well as a large display of diagrams, apparatus and publications bearing directly or indirectly on the agricultural applications of meteorology. Many of the diagrams were prepared specially for the occasion. Among these may be mentioned a coloured representation of Mr. R. H. Hooker's climate and crop correlations for the east of England, and a diagram in which the harvest weather forecasts issued during 1921 were shown alongside a generalised representation of the weather day by day in the east and south-east districts.

E. G. B.

Weather Conditions favourable for Good Crops in Eastern England.

In the Meteorological Office Circular, August 1919, a coloured diagram was reproduced to illustrate the results of Mr. R. H. Hooker's study of the correlation of the weather and crops in

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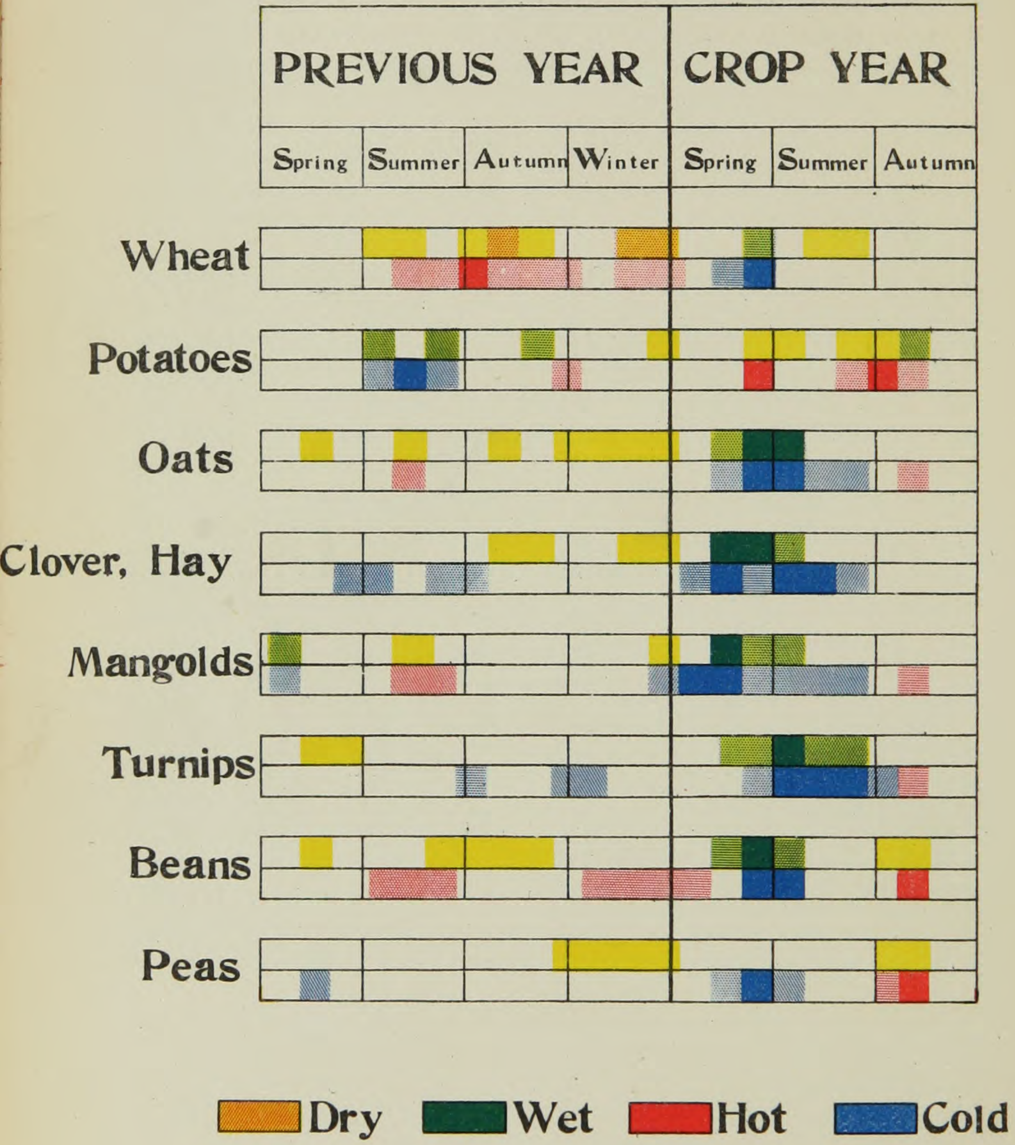
* *The Wireless Weather Manual.* M.O. Publication No. 255.

To face page 163.

WEATHER CONDITIONS FAVOURABLE FOR GOOD CROP YIELDS IN EASTERN ENGLAND.



🟥 Indicates that comparatively high temperature for the time of the year is very favourable for the crops.

▨ Indicates that comparatively high temperature for the time of the year is somewhat favourable for the crops.

☐ Indicates that the effect of temperature in the crop is not marked.

Similar remarks apply to the other shades.

BASED ON R. H. HOOKER'S
" The weather and the crops in Eastern England "
1885–1921.

Office Press Kingsway W.C.2
PS.17597/541. Wt.69. D.P.1/SDP.7353. 1000. 7/22.

Eastern England.* In his presidential address to the Royal Meteorological Society last January,† Mr. Hooker placed his work on a surer foundation by utilising statistics covering 35 years, the earlier investigation having been based on the figures for 21 years only.

The accompanying illustration represents Mr. Hooker's new results.

In the paper the correlation coefficient for the size of the crop and the temperature of a period of eight weeks such as that from the 33rd to the 40th week is given. The periods of eight weeks overlap, however, and for our diagram each correlation coefficient has been regarded as characteristic of the central four weeks. For example, in the case of wheat, Hooker finds the correlation between the yield and the temperature of the period of eight weeks 33rd to 40th of the previous year is + ·40. We represent this by the deep red of the interval 35th to 38th weeks. Spring, *i.e.*, March, April, May commences with the 10th week of the year and so on. The colour scheme is shown under the diagram; "very favourable" is given when he correlation coefficient exceeds 0·40; "somewhat favourable" when the coefficient is between 0.20 and 0·40; "effect of temperature or rainfall not marked" when the coefficient is less than 0·20.

As to the significance of the diagram, readers are referred to Mr. Hooker's Address and to the discussion which is summarised in the last issue of the Meteorological Magazine. It is interesting to notice how general is the influence on the crops of the weather of the preceding year. This influence Mr. Hooker attributed to the requirements for good seed, but other authorities have laid stress on the effect of the weather on the condition of the ground at the time of sowing. At the end of a wet summer the ground is likely to be choked with weeds and require more careful tillage to secure satisfactory crops.

"May Dust."

(*Extract from the "Barbados Advocate," May 23rd, 1922.*)

"A PECULIAR phenomenon which has spread over the whole Carribbean from Barbados to St. Kitts and extending south almost to Demerara has been the prevalence of a low hanging mist which has shut off the horizon. For some time the idea prevailed that it was dust due to volcanic eruption, but this was removed by the reports from vessels arriving and from advices from the neighbouring islands.

"Captains trading in these waters for years state that they have never before experienced such continued low visibility at this time of the year. No scientific explanation of the phenomenon has yet been offered."

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* *J.R. Stat. Soc.* 70, 1907, p. 1.

† *Q.J.R. Met. Soc.*, Vol. XLVIII, No. 202, p. 115–138.

London to Paris Night Flights.

On May 31st a practical test of the lighting of the London-Paris air-way for night-flying on a commercial scale was carried out by General Brancker, Director of Civil Aviation, and Colonel Blandy, Controller of Communications, in a Handley Page service machine. The party, which also included Lieut. Biddlecombe, with a pilot, wireless operator and mechanic, left the London Terminal Aerodrome at Croydon at 22h. 20m. B.S.T., and, flying by compass and the guidance of aerial and coastal lighthouses, landed without difficulty at Le Bourget at 1h. 54m. B.S.T. on June 1st.

In order that the navigator before starting should have later weather observations than those usually available special 18h. and 20h. G.M.T. reports from stations in north-east France were obtained by previous arrangement by wireless from Le Bourget, and from the British stations on the route by telephone, and collected at the Meteorological Office at Croydon.

The weather was favourable, with little wind, though mist tended to obscure the ground at times.

The return journey was made in daylight.

On June 7th a night-flight from Le Bourget to Croydon was made by French personnel in a Farman-Goliath commercial machine. In this instance reports from south-east England were requested about an hour beforehand by the French Meteorological Office and as arrangements had been made in anticipation of such a request reports from 20h. to 24h. G.M.T. from Croydon, Biggin Hill and Lympne were available at the wireless stations on the route. Some of these were communicated by radio-telephony to the machine in flight.

The aeroplane left Paris at 22h 17m. B.S.T. and reached Croydon at 1h. 11m. on June 8th, the return flight being commenced after a short interval at 2h. 39m. and finished at 6h. 6m.

The weather on the British side was fine, with good visibility, but over north-east France a thunderstorm and, later, rain-squalls were encountered.

Curious Temperature Effect.

An interesting example of an inversion of temperature is reported from Benson Observatory, Wallingford. The frost on May 13th caught a walnut tree just as the leaves were beginning to come out. The tree was about 40 feet high: the foliage on the lower part was destroyed by the frost, while the top of the tree was not affected. The minimum temperature recorded in the screen for that date was 25°F.

The Mount Everest Expedition.

NEWS received by the Mount Everest Committee during June shows that much has been achieved by this Expedition, even though the prospects of full success this year have been reduced to a minimum by the early breaking of the monsoon on June 3rd. All altitude records had been broken on May 21st by Mr. Mallory, Major Norton, and Mr. Somervell, who, without using oxygen, reached 26,800 feet, and with hardly more physical discomfort than at the base camp at 25,000 feet, though the two first named were more or less frost-bitten. On a second attempt Mr. Finch and Captain Geoffrey Bruce, using oxygen, reached the still greater height of 27,200 (subsequently given as 27,300) feet, or only some 1,700 feet below the summit. Captain Finch's detailed account shows clearly the great difficulties entailed by the rough weather prevalent at the higher levels, the climbers having spent the night before the final push at 25,500 feet, to the accompaniment of a veritable gale of wind with heavy snow and very low temperature. Thanks to Captain Finch's ingenuity in repairing defects in the oxygen apparatus, the benefits derived from its use were most marked, even a moderate supply greatly encouraging both sleep and appetite. The final effort was to have been made on June 6th, but was frustrated by the monsoon, as already stated, and several members of the expedition, some suffering from frost-bite, have since returned to Darjeeling. In the absence of further official news it is impossible to judge whether the undertaking is being definitely abandoned for the present year, or whether a further attempt will be made, possibly in September. The general conclusion seems to be that rough weather is one of the greatest obstacles to success, and that the physiological effects of altitude may be more easily overcome than had been anticipated.

Weather Reports from America.

BY agreement between the United States Weather Bureau and the French National Meteorological Service, coded weather reports are received in France from America by wireless telegraphy. These reports are broadcasted as an addition to a collective message, issued daily from the Eiffel Tower at 11h. 30m. G.M.T., which gives a synopsis of weather conditions over Europe by means of observations from selected stations. The American observations embrace barometric pressure, wind direction and wind force at about 30 stations forming a network over the whole of the United States and including in addition, Bermuda and several stations in Canada. They are made at 1h. G.M.T. of the day of issue, and when combined with European observations and observations received by wireless telegraphy from ships in the Atlantic, enable the Meteorological Office, Air Ministry, to obtain a representation of the meteorological situation, within 12 hours of the time of observation, over a large section of the Northern Hemisphere extending from the Pacific seaboard of America in the west to Russia and Egypt in the East.

This marks an important addition to the services which wireless telegraphy is rendering to meteorological science.

Simple Weather Forecasting.

In the April number of this Magazine a note was published under the heading " A Test of Simple Weather Forecasting " in which the dictum " When the cold snap in the spring occurs early, the summer will be early " was discussed. Reference to the book *Simple Weather Forecasting for Everyone* shows that the correct quotation (p. 35) is " If this ' May Weather ' comes early we can generally expect an early summer, but if late the summer will usually be belated also," which should be read in conjunction with the statement (p. 13) " Although the tendency is for this period " (*i.e.*, the May cold weather period) " to occur about the 12th of May, it may happen as early as the middle of April or as late as mid-June."

The investigation with regard to cold snaps in February and March was entirely beside the point and the criticism based on it must be withdrawn. We offer our apologies to Messrs. Horner and Robertson, the authors of *Simple Weather Forecasting for Everyone.*

Reviews.

Niederschlags-Schwankungen in Norwegen. Erste Mitteilung. By B. J. Birkeland. Geofysiske Publ., Vol. I., No. 3. Kristiania, 1920. Size 12 by 9, pp. 62, 2 plates.

This volume deals in great detail with the rainfall of twenty stations in Norway covering the forty years 1876 to 1915. The actual monthly and annual figures are dealt with very briefly, only the normals being given in Table I., but the bulk of the work is concerned with the individual monthly totals treated as percentages of the forty-year annual mean for each station. These figures are discussed, without regard to their absolute values, as deviations from the corresponding monthly normals. To take an example, at Skudenes the normal January rainfall is 9·1 per cent. of the normal annual fall (40 years), while in

January, 1915, the total was only 7·8 per cent. of the normal annual fall for the forty years; the deviation from normal is accordingly —1·3 " per cent. of annual normal." It is claimed for this method that in calculating the deviation of rainfall over the whole country by its use, the records at the drier stations are not masked by those at the wetter stations. Since the annual rainfall at different places in Norway varies from 250 to 3,000 mm., the ordinary methods of calculating regional rainfall distribution give undue weight to the wetter regions. Birkeland's method gives equal value to all stations according to the percentage variation; it should also be noticed that at any one station a deviation from the monthly normal of, say, 10 mm., in whatever month it occurs, always has the same value.

At Bergen, which has a rainfall record commencing in 1851, the 56 years ending in 1916 were formed into 17 consecutive 40-year annual means, and it was found that the mean departure from the 56-year normal was only 1·00 per cent. The probable error of the 40-year mean at all stations was calculated at 2·0 per cent. The probability of the occurrence of high and low percentage values in each month is also considered.

H. Mohn. Atlas de Climat de Norvège. Nouvelle édition par Aage Graarud et Kristen Irgens. Geofysiske Publ., Vol. II., No. 7. Kristiania, 1921. Size 12 by 9, pp. 5, plates 60.

THIS useful work is a new edition of the *Atlas of Norwegian Climate* compiled by H. Mohn, mainly on the basis of his well-known *Klima-Tabeller for Norge.* The present atlas is based on the values for the 40 years 1874 to 1913, incomplete records being reduced by comparison. The former year is that in which observations in Norway were first organised in international form, as a result of the first Congress at Vienna in 1873.

The charts are clearly reproduced in black and white on the scale of 1 : 7,500,000, which gives one map to a page. They include mean monthly temperature, reduced to sea level, annual range, warmest and coldest days and extreme temperatures. The method of calculating the warmest and coldest days is interesting. The temperatures of the middle day of each month were plotted, and through the three highest a parabola was drawn with its axis parallel to the temperature ordinate; the highest point gave the warmest day. The coldest day was found in a similar way. The extremes were taken directly from the records; presumably no correction was applied for height or length of record; in such a mountainous country neglect of the former correction must somewhat reduce the value of the data. The effect of the warm coastal waters is well shown in several of these charts. Days of mean temperature below 0° C. and days of frost complete the temperature charts. Then follow maps of vapour tension and relative humidity (for four months only), pressure and wind by months, and wind force, days of gale, cloudiness, fogs and thunderstorms by seasons. The maps of fog distribution rather strongly suggest the presence of the personal equation, but even so they are of great interest, especially as showing the oscillation of the area of greatest fog from the south in winter to the north in summer. A rather surprising point is the omission of annual charts (except for the days below 0° C. and days of frost); we are not told whether this was due to the additional labour or expense involved or whether, in common with some other meteorologists, the authors regard annual charts as of little value.

There are no rainfall charts in this volume, such having already been published in great detail in connection with the series *Nedboriagttelser i Norge*, the last edition being in 1921. The combination of these two sets gives a very valuable graphic presentation of the climate of Norway, which will be welcomed by all meteorologists.

News in Brief.

THE Meteorological Office was drawn against the Finance Department in the first round of the Inter-departmental Cricket Competition of the Air Ministry.

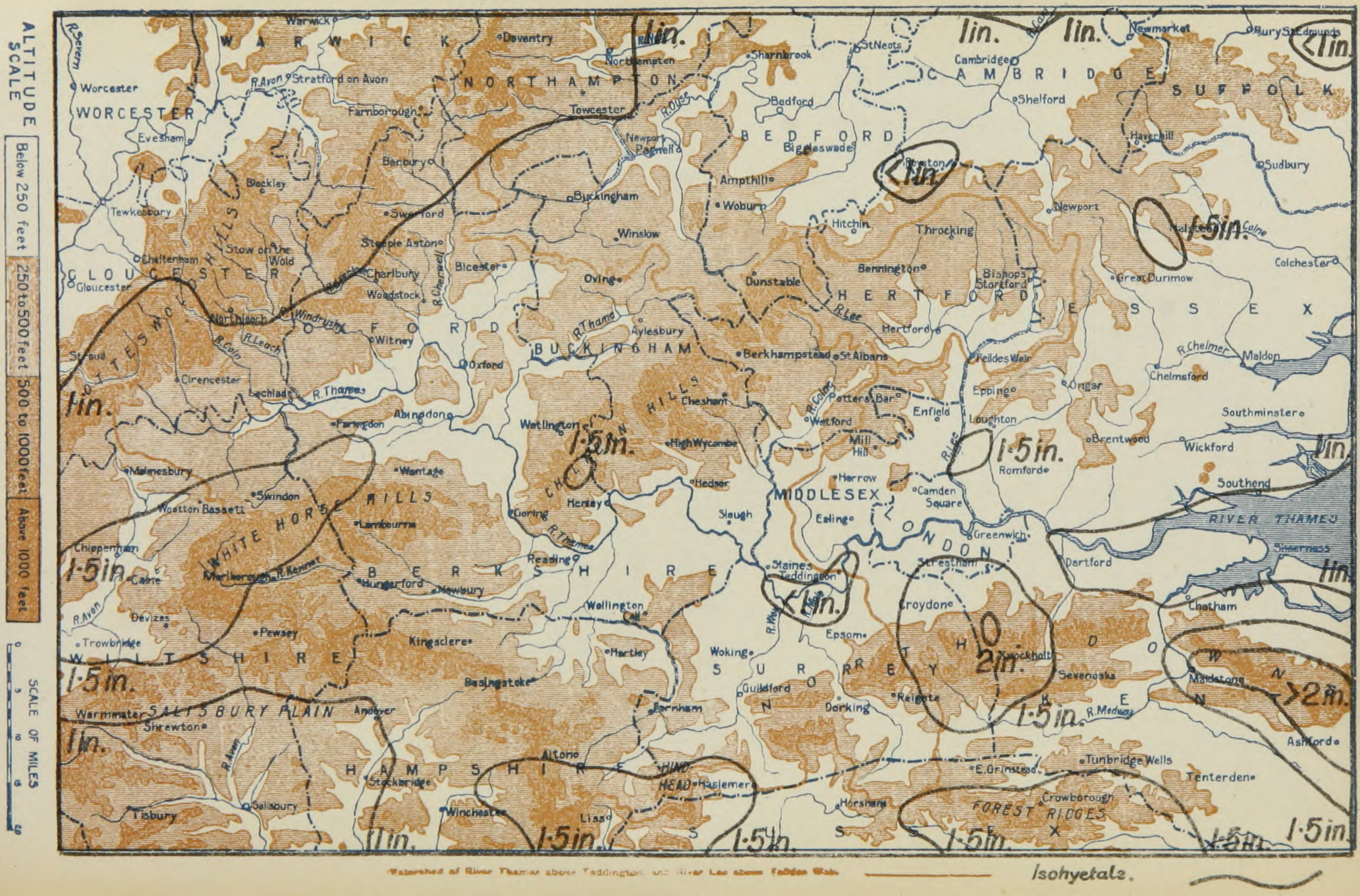
The match was played at Eltham on Friday, June 23rd, the Meteorological Office team being captained by Mr. C. W. Lamb. The game resulted in a win for the Office after a very exciting struggle, the scores being 72 and 62. The honours went to Mr. E. G. Ward, who scored 28 and was responsible for 6 wickets at a small cost.

The team was encouraged in its efforts by the presence of the Director and several other memers of the Staff.

A Climatological station of the Health Resort type has been established at North Berwick under municipal auspices. The site is at the hospital on the outskirts of the town. Since July 5th the afternoon observations have been included in the schedule issued to the newspapers by the Meteorological Office, London.

The Climatological station at Ridgewell is being closed at the end of July, and Mr. F. J. Gurney is anxious to dispose of the meteorological instruments there. Readers wishing for particulars should communicate with him at Ridgewell Hill, Halstead, Essex.

THAMES VALLEY RAINFALL —— JUNE, 1922.


ALTITUDE SCALE
Below 250 feet
250 to 500 feet
500 to 1000 feet
Above 1000 feet
SCALE OF MILES
0
5
10
15
20
Watershed of River Thames above Teddington and River Lee above Feildes Weir.
Isohyetals.
WARWICK
NORTHAMPTON
CAMBRIDGE
SUFFOLK
WORCESTER
BEDFORD
GLOUCESTER
OXFORD
BUCKINGHAM
HERTFORD
ESSEX
MIDDLESEX
LONDON
BERKSHIRE
WILTSHIRE
SURREY
HAMPSHIRE
SUSSEX
KENT
COTSWOLD HILLS
WHITE HORSE HILLS
CHILTERN HILLS
NORTH DOWNS
SALISBURY PLAIN
FOREST RIDGES
HIND HEAD
RIVER THAMES
R. Severn
R. Avon
R. Ouse
R. Cherwell
R. Windrush
R. Leach
R. Coln
R. Thame
R. Thames
R. Kennet
R. Colne
R. Lee
R. Chelmer
R. Medway
R. Wey
Worcester
Warwick
Stratford on Avon
Deventry
Northampton
Towcester
Farnborough
Evesham
Banbury
Blockley
Tewkesbury
Swerford
Steeple Aston
Stow on the Wold
Cheltenham
Charlbury
Woodstock
Gloucester
Northleach
Witney
Stroud
Cirencester
Lechlade
Farringdon
Abingdon
Oxford
Bicester
Oving
Winslow
Buckingham
Newport Pagnell
Aylesbury
Wantage
Malmesbury
Swindon
Wootton Bassett
Lambourne
Chippenham
Calne
Marlborough
Hungerford
Newbury
Devizes
Pewsey
Trowbridge
Kingsclere
Warminster
Shrewton
Andover
Basingstoke
Tisbury
Salisbury
Stockbridge
Winchester
Alton
Liss
Haslemere
Farnham
Hartley
Wellington Coll.
Reading
Goring
Henley
Watlington
High Wycombe
Hedsor
Chesham
Slough
Berkhampstead
St Albans
Dunstable
Ampthill
Woburn
Bedford
Biggleswade
Sharnbrook
St Neots
Hitchin
Royston
Throcking
Bennington
Hertford
Potters Bar
Watford
Mill Hill
Harrow
Ealing
Staines
Teddington
Enfield
Camden Square
Greenwich
Streatham
Croydon
Epsom
Woking
Guildford
Dorking
Reigate
Knockholt
Sevenoaks
Horsham
E. Grinstead
Tunbridge Wells
Crowborough
Tenterden
Ashford
Maidstone
Chatham
Dartford
Sheerness
Southend
Wickford
Southminster
Brentwood
Romford
Loughton
Epping
Ongar
Feildes Weir
Bishops Stortford
Chelmsford
Maldon
Great Dunmow
Halstead
Colchester
Newport
Haverhill
Sudbury
Shelford
Cambridge
Newmarket
Bury St Edmunds
1in.
<1in.
1·5in.
2in.
>2in.

H.M. Stationery Office Press, Kingsway, W.C.2.

Ps.1672/558. Wt.69 D.P.1. 1250. 7/22.

Snow on the Pordio and Falzarego Passes in the Italian Tyrol melted sufficiently for the first public motor-coach service of the season to be run on May 30th over the entire length of the Dolomite Road.

Four fine water spouts swiftly approached Biarritz from the sea on the early morning of June 21st. They dispersed on reaching the sands.

The Weather of June, 1922.

THE weather of the first week of June was dry and hot, generally continuing the drought of the previous month, so that in many places there was anxiety with regard to water supplies and to the condition of crops. In the second half of the month a series of depressions, approaching Europe from the Atlantic, gave unsettled, cool weather with considerable rainfall and strong winds.

On the 1st a deep depression over Finland and a High to the north of Scotland caused northerly gales over Scandinavia, Denmark and northern Germany, while the British Isles and France were in a "flat" area. Fine, hot weather was enjoyed in the latter districts with day temperatures reaching 85° F. in most places. On the 2nd a shallow depression approaching the Hebrides caused an increase of wind in the west, with a lowering of temperature and thunderstorms at some places in the British Isles, France and Switzerland. This shallow depression deepened considerably as it moved N.E. on the 2nd; it then remained almost stationary off the east coast of Iceland until the 5th, during which time it gradually filled up. Further south the Azores anticyclone extended slowly in a north-easterly direction, bringing finer and warmer weather to England, France and the Netherlands, although heavy rain was associated with a shallow V-shaped depression moving across Denmark and northern Germany on the 4th. Thunderstorms at Geneva and Guernsey on the 6th gave heavy rain locally. On the 8th a shallow depression developed over France. This depression moved north, giving a definite, if weak, cyclonic circulation over England on the 9th. No rain showers were associated with this depression except in Wales and south-west England.*

Heavy rain associated with an irregular system of Lows over Central Europe fell in France, Switzerland and Denmark on the 10th and 11th, while the weather of Great Britain, improving on the 10th became fair on the 11th and 12th as the anticyclone north-east of the Azores extended

(*Continued on p.* 175.)

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* The track of a sample of air crossing the Norfolk coast on the morning of the 8th showed a slow movement to Wales and then an abrupt turn eastwards, the air then passing near Ross and Benson and finally across London on the afternoon of the 10th. It was always dry, and the temperature of the upper air over Helder on the 8th was well above the normal. Over England the upper winds were generally easterly up to at least 6,000 feet on the 8th, and were south-westerly in the south but still easterly in the north on the 9th. Mr. E. V. Newnham, to whom this observation is due, remarks: "It seems safe to conclude that dryness of the air combined with high temperatures up above prevented the formation of any considerable rain area."

Rainfall Table for June 1922.

STATION.	COUNTY.	Aver. 1881—1915.	1922.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	2·02	1·12	28	55	·42	28	9
Tenterden (View Tower)	*Kent*	1·91	1·21	31	63	·26	14	12
Arundel (Patching Farm)	*Sussex*	2·02	1·79	45	89	·43	26	12
Fordingbridge (Oaklands)	*Hampshire*	1·85	·87	22	47	·20	13	11
Oxford (Magdalen College)	*Oxfordshire*	2·13	1·30	33	61	·47	13	8
Wellingborough (Swanspool)	*Northampton*	2·10	1·20	31	57	·29	13	11
Hawkedon Rectory	*Suffolk*	2·07	1·14	29	55	·39	28	11
Norwich (Eaton)	*Norfolk*	1·93	1·67	42	87	·57	13	13
Launceston (Polapit Tamar)	*Devon*	2·15	1·15	29	53	·32	25	11
Sidmouth (Sidmount)	„	2·10	·67	17	32	·22	25	9
Ross (County Observatory)	*Herefordshire*	2·15	·58	15	27	·17	13	8
Church Stretton (Wolstaston)	*Shropshire*	2·42	1·12	28	46	·21	24	11
Boston (Black Sluice)	*Lincoln*	1·82	1·16	29	64	·35	13	9
Worksop (Hodsock Priory)	*Nottingham*	1·98	·86	22	43	·39	13	9
Mickleover (Clyd House)	*Derbyshire*	2·39	·91	23	38	·25	29	11
Southport (Hesketh Park)	*Lancashire*	2·17	2·14	54	99	·50	27	14
Wetherby (Ribston Hall)	*York, W. R.*	2·10	2·09	53	100	·56	24	7
Hull (Pearson Park)	„ *E. R.*	2·06	1·04	..	50	·27	13	11
Newcastle (Town Moor)	*North'land*	2·17	1·75	44	81	·36	23	13
Borrowdale (Seathwaite)	*Cumberland*	6·52	8·10*	206	124	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	2·49	1·21	31	49	·31	25	13
Haverfordwest (Gram. Sch.)	*Pembroke*	2·70	2·30	58	85	·65	9	10
Aberystwyth (Gogerddan)	*Cardigan*	3·11	2·01	51	65	·45	12	9
Llandudno	*Carnarvon*	2·03	1·45	37	71	·33	12	13
Dumfries (Cargen)	*Kirkcudbrt.*	2·78	2·04	52	73	·41	22	16
Marchmont House	*Berwick*	2·31	1·57	40	68	·65	12	11
Girvan (Pinmore)	*Ayr*	2·89	4·00	102	139	1·02	18	21
Glasgow (Queen's Park)	*Renfrew*	2·31	1·57	40	68	·25	12	14
Islay (Eallabus)	*Argyll*	2·62	3·52	89	134	·45	21	21
Mull (Quinish)	„	2·97	3·87	98	130	·64	12	22
Loch Dhu	*Perth*	4·17	3·10	79	74	·55	22	17
Dundee (Eastern Necropolis)	*Forfar*	1·80	1·84	47	102	·41	22	16
Braemar (Bank)	*Aberdeen*	1·96	1·30	33	66	·24	23	12
Aberdeen (Cranford)	„	1·80	2·39	61	133	·57	12	16
Gordon Castle	*Moray*	2·04	1·60	41	78	·49	12	17
Fort William (Atholl Bank)	*Inverness*	3·58	4·00	102	112	·53	9	24
Alness (Ardross Castle)	*Ross*	2·26	1·04	26	46	·17	9	18
Loch Torridon (Bendamph)	„	4·08	5·55	141	136	·56	28	24
Stornoway	„	2·32	2·73	69	118	·31	19	24
Loch More (Achfary)	*Sutherland*	3·70	5·69	145	154	·65	18	27
Wick	*Caithness*	1·80	1·81	46	101	·26	25	23
Glanmire (Lota Lodge)	*Cork*	2·70	1·33	34	49	·33	30	12
Killarney (District Asylum)	*Kerry*	2·91	2·09	53	72	·34	9	21
Waterford (Brook Lodge)	*Waterford*	2·69	1·17	30	44	·40	30	12
Nenagh (Castle Lough)	*Tipperary*	2·45	..	..	..	..	..	..
Foynes	*Limerick*	2·58	..	..	..	..	..	..
Gorey (Courtown House)	*Wexford*	2·43	1·13	29	47	·41	30	8
Abbey Leix (Blandsfort)	*Queen's Co.*	2·59	1·77	45	68	·31	29	16
Dublin (FitzWilliam Square)	*Dublin*	1·95	·78	20	40	·16	12	12
Mullingar (Belvedere)	*Westmeath*	2·60	1·36	35	52	·22	25	14
Crossmolina (Enniscoe)	*Mayo*	3·00	..	..	..	..	..	..
Collooney (Markree Obsy.)	*Sligo*	3·01	3·03	77	101	·55	24	21
Seaforde	*Down*	2·76	2·18	55	79	·35	27	13
Ballymena (Harryville)	*Antrim*	2·91	2·44	62	84	·43	22	19
Omagh (Edenfel)	*Tyrone*	2·82	3·27	83	116	·50	22	20
Letterkenny Asylum	*Donegal*	2·90	2·23	57	77	·30	24	19

* Read on 2nd July.

Supplementary Rainfall, June 1922.

Div.	STATION.	RAIN.		Div.	STATION.	RAIN.	
		in.	mm.			in.	mm.
II.	Ramsgate	1·75	44	XII.	Langholm, Drove Rd.	2·64	67
"	Sevenoaks, Speldhurst	1·54	39	XIII.	Ettrick Manse	1·80	46
"	Hailsham Vicarage	1·51	38	"	North Berwick Res.	1·88	48
"	Totland Bay, Aston Ho.	1·08	27	"	Edinburgh, Royal Ob.	1·69	43
"	Ashley, Old Manor Ho.	1·79	45	XIV.	Biggar	1·75	44
"	Grayshott	2·02	51	"	Leadhills	5·13	130
"	Ufton Nervet	1·25	32	"	Kilmarnock, Agric. Coll.	3·02	77
III.	Harrow Weald, Hill Ho.	1·30	33	XV.	Dougarie Lodge	4·05	103
"	Pitsford, Sedgebrook	·90	23	"	Oban	4·16	106
"	Chatteris, The Priory	·84	21	"	Holy Loch, Ardnadam	4·01	102
IV.	Elsenham, Gaunts End	1·09	28	"	Tiree, Cornaigmore	..	..
"	Lexden, Hill House	1·08	27	XVI.	Loch Venachar	2·30	58
"	Aylsham, Rippon Hall	1·65	42	"	Glenquey Reservoir	2·10	53
"	Swaffham	1·18	30	"	Loch Rannoch, Dall	2·04	52
V.	Devizes, Highclere	1·56	40	"	Blair Atholl	1·26	32
"	Weymouth	·71	18	"	Coupar Angus	1·58	40
"	Ashburton, Druid Ho.	·97	25	"	Montrose Asylum	1·21	31
"	Cullompton	1·03	26	XVII.	Logie Coldstone, School	1·60	41
"	Hartland Abbey	1·43	36	"	Fyvie Castle	2·01	51
"	Penzance, Morrab Gden.	1·09	28	"	Grantown-on-Spey	1·42	36
"	St. Austell, Trevarna	1·37	35	XVIII.	Kingussie, Fasnakyle	1·95	49
"	Crewkerne Merefield Ho	·69	17	"	Fort Augustus	1·76	45
VI.	Clifton College	1·54	39	"	Loch Quoich, Loan	9·70	246
"	Ledbury, Underdown	·74	19	"	Fortrose	·64	16
"	Shifnal, Hatton Grange	·56	14	"	Faire-na-Squir	4·43	113
"	Ashbourne, Mayfield	1·15	29	"	Skye, Dunvegan	4·04	103
"	Barnt Green, Upwood	·86	22	XIX.	Loch Carron, Plockton	3·46	88
"	Blockley, Upton Wold	·83	21	"	Dornoch, St. Gilbert's	1·14	29
VII.	Leicester, Town Hall Sq.	·52	13	"	Tongue Manse	3·50	89
"	Grantham, Saltersford	1·04	26	"	Melvich Schoolhouse	2·30	58
"	Louth, Westgate	1·32	33	XX.	Dunmanway Rectory	1·54	39
"	Mansfield, West Bank	1·37	35	"	Mitchelstown Castle	..	..
VIII.	Nantwich, Dorfold Hall	1·43	36	"	Gearahameen	1·80	46
"	Bolton, Queen's Park	3·10	79	"	Darrynane Abbey	1·41	36
"	Lancaster, Strathspey	3·04	77	"	Cashel, Ballinamona	1·44	37
IX.	Wath-upon-Dearne	·71	18	"	Roscrea, Timoney Park	..	..
"	Bradford, Lister Park	1·41	36	"	Ballybunion	..	..
"	West Witton	1·56	40	"	Broadford. Hurdlestown	2·59	66
"	Scarborough, Scalby	1·97	50	XXI.	Kilkenny Castle	1·42	36
"	Middlesbro', Albert Pk.	1·65	42	"	Rathnew, Clonmannon	1·11	28
"	Mickleton	1·20	31	"	Hacketstown Rectory	..	..
X.	Bellingham	1·59	40	"	Balbriggan, Ardgillan	1·20	31
"	Ilderton, Lilburn	1·43	36	"	Drogheda	1·13	29
"	Orton	2·44	62	"	Athlone, Twyford	1·22	31
XI.	Llanfrechfa Grange	..	..	XXII.	Castle Forbes Gdns.	1·46	37
"	Treherbert, Tyn-y-waun	2·58	65	"	Ballynahinch Castle	3·82	97
"	Carmarthen Friary	1·96	50	"	Galway, Grammar Sch.	1·59	40
"	Lampeter, Falcondale	1·87	47	XXIII.	Westport House	..	..
"	Cray Station	1·80	46	"	Enniskillen, Portora	2·30	58
"	B'ham W.W., Tyrmyndd	1·87	47	"	Armagh Observatory	2·15	55
"	Lake Vyrnwy	3·15	80	"	Warrenpoint	1·57	40
"	Llangynhafal, P. Drâw	1·75	44	"	Belfast, Cave Hill Rd.	2·54	65
"	Oakley Quarries	4·21	107	"	Glenarm Castle	1·93	49
"	Dolgelly, Bryntirion	2·88	73	"	Londonderry, Creggan	3·36	85
"	Snowdon, L. Llydaw	7·77	197	"	Sion Mills	2·21	56
"	Lligwy	1·72	44	"	Milford, The Manse	2·63	67
XII.	Stoneykirk, Ardwell Ho.	..	..	"	Narin, Kiltoorish	3·43	87
"	Carsphairn, Shiel	3·26	83	"	Killybegs, Rockmount	4·43	113

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L. mb.	Diff. from Normal mb.	Max. ° F.	Date	Min. ° F.	Date	Max. ° F.	Min. ° F.	½ max. and min. ° F.	Diff. from Normal ° F.
London, Kew Observatory	1009·8	−7·5	57	2	26	18	45·3	35·4	40·4	+1·5
Gibraltar	1020·1	+0·6	68	29	42	67	61·6	50·0	55·8	+0·2
Malta	1012·8	−3·4	65	31	41	6	57·5	50·7	54·1	−0·5
Sierra Leone	1010·9	−0·3	93	18	68	2	89·3	73·9	81·6	+0·1
Lagos, Nigeria	1013·3	+3·4	90	18	69	12	87·0	74·9	80·9	−0·1
Kaduna, Nigeria	..	..	..	..	..	..	..	..	..	..
Zomba, Nyasaland	1006·7	−1·2	91	18, 20, 31	60	4	83·0	64·3	73·7	+1·3
Salisbury, Rhodesia	1004·8	−4·5	96	19	42	4	89·9	53·4	71·7	+2·2
Cape Town	1012·7	−0·7	92	4	49	17	78·9	58·3	68·6	−1·2
Johannesburg	1010·0	+0·3	85	18	49	1	79·7	57·4	68·5	+2·3
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	..	..	95	20	53	31	88·4	60·7	74·5	+1·3
Calcutta, Alipore Obsy.	1014·9	−0·3	84	1	51	6	78·6	56·5	67·5	+1·1
Bombay	1012·5	−0·7	89	4	60	3	83·7	68·2	75·9	+0·7
Madras	1015·3	+1·4	87	30	64	30	83·5	68·4	75·9	−0·2
Colombo, Ceylon	1010·8	0·0	93	26	67	24	88·3	71·7	80·0	+0·2
Hong Kong	1018·8	−0·6	74	9	48	19	64·5	57·6	61·1	+0·8
Sandakan	..	..	88	17, 24, 25	73	8, 22, 31	85·2	74·7	79·9	0·0
Sydney	1007·7	−4·8	97	5	56	26	78·7	63·3	71·0	−0·6
Melbourne	1008·8	−4·1	101	22	48	17	78·3	56·9	67·6	+0·1
Adelaide	1009·6	−3·4	103	18	50	14	80·5	59·6	70·1	−4·0
Perth, Western Australia	1012·0	−0·5	99	14	55	6	82·3	61·6	71·9	−1·9
Coolgardie	1009·2	−2·2	109	16	48	6	93·6	62·0	77·8	+0·4
Brisbane	1006·9	−4·4	99	29	61	2	87·8	69·7	78·7	+1·5
Hobart, Tasmania	1008·5	−1·8	94	18	45	30	70·0	53·7	61·9	−0·4
Wellington, N.Z.	1015·6	+2·8	75	31	47	30	68·2	55·0	61·6	−1·1
Suva, Fiji	1006·2	−1·5	91	26, 31	68	8	86·7	72·1	79·4	−0·5
Kingston, Jamaica	1014·6	−0·7	89	30	65	3	86·0	68·1	77·1	+0·3
Grenada, W.I.	1013·0	+0·2	86	4, 8, 9	70	8, 9, 15	82·6	72·9	77·7	+0·7
Toronto	1021·9	+4·5	46	5	− 1	2	30·1	16·4	23·3	+1·2
Winnipeg	1020·0	+0·2	35	28	−38	22	12·0	−6·0	3·0	+7·4
St. John, N.B.	1017·4	+1·7	44	12	−13	24	26·9	8·2	17·5	−1·7
Victoria, B.C.	1021·1	+5·8	47	10	21	30	39·9	32·7	36·3	−3·8

London, Kew Observatory.—Prevailing wind direction westerly, mean speed 9·4 mi/hr. 4 days with snow.

Gibraltar.—Prevailing wind direction W. 5 days with gale.

Malta.—Prevailing wind direction westerly. 8 days with hail, 3 days with thunder heard, 2 days with gale.

Sierra Leone.—Calms predominate over S.W. 12 days with harmattan.

Salisbury, Rhodesia.—Prevailing wind direction SE.

Colombo, Ceylon.—Prevailing wind direction N., tendency to NW. in late afternoon, mean speed 6·0 mi/hr. 2 days with thunder heard.

Adelaide :—										
Dec. 1921 - -	1013·7	+0·5	97	19	51	15	81·3	58·8	70·1	−1·1
Year 1921 - -	1017·4	+0·3	110	Jan.23	37	June 27 Aug. 6	74·5	54·8	64·7	+1·7

British Empire, January 1922.

TEMPERATURE				PRECIPITATION				BRIGHT SUNSHINE		
Mean	Absolute	Relative Humidity	Mean Cloud Am'nt	Amount		Diff. from Normal	Days	Hours per day	Percentage of possible	STATIONS
Wet Bulb.	Min. on Grass									
° F.	° F.	%	0–10	in.	mm.	mm.				
39·2	32	84	7·5	2·23	57	+ 12	20	1·6	18	London, Kew Observatory.
52·0	33	79	4·2	2·35	60	− 70	9	..	..	Gibraltar.
50·1	35	81	6·7	3·64	92	+ 17	20	3·8	38	Malta.
74·1	..	66	1·9	0·00	0	− 11	0	..	..	Sierra Leone.
74·7	68	88	9·3	0·59	15	− 13	2	..	..	Lagos, Nigeria.
..	..	..	..	..	..	..	..	..	..	Kaduna, Nigeria.
..	..	78	3·9	0·95	24	−261	6	..	..	Zomba, Nyasaland.
64·4	..	50	..	0·79	20	−181	2	..	..	Salisbury, Rhodesia.
62·8	..	59	3·5	1·66	42	+ 25	8	..	..	Cape Town.
58·8	47	65	4·2	2·58	66	− 93	18	9·0	66	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
62·0	..	54	2·7	1·85	47	− 55	8	..	..	Bloemfontein.
57·7	42	37	2·2	0·00	0	− 10	0*	..	..	Calcutta, Alipore Obsy.
68·0	50	64	0·9	0·00	0	− 2	0*	..	..	Bombay.
70·7	60	76	3·9	3·42	87	+ 64	7*	..	..	Madras.
74·4	58	64	4·4	2·12	54	− 37	9	..	..	Colombo, Ceylon.
57·2	..	81	8·3	2·66	68	+ 31	15	3·1	28	Hong Kong.
77·1	..	89	..	19·43	494	+ 25	19	..	..	Sandakan.
65·8	50	65	5·1	7·01	178	+ 87	20	7·5	53	Sydney.
59·5	40	53	5·2	1·18	30	− 17	10	..	..	Melbourne.
58·4	40	44	4·5	2·22	56	+ 38	8	9·3	66	Adelaide.
63·3	48	54	3·2	0·10	3	− 6	3	10·3	74	Perth, Western Australia.
63·0	..	30	2·5	0·00	0	− 12	0	..	..	Coolgardie.
71·4	56	61	4·7	3·62	92	− 71	11	..	..	Brisbane.
55·6	40	64	7·0	2·61	66	+ 21	23	6·1	41	Hobart, Tasmania.
57·1	33	75	7·0	0·68	17	− 69	12	5·6	38	Wellington, N.Z.
77·2	..	80	5·7	25·15	639	+367	16	..	..	Suva, Fiji.
..	..	71	4·5	0·35	9	− 15	3	..	..	Kingston, Jamaica.
72·5	..	75	3·9	6·24	158	+ 45	22	..	..	Grenada, W.I.
19·3	—4	51	5·9	1·38	35	− 38	11	..	..	Toronto.
0·8	..	..	4·0	0·27	7	− 12	4	..	..	Winnipeg.
14·8	−14	58	4·1	3·36	85	− 37	8	..	..	St. John, N.B.
34·2	16	88	6·3	2·77	70	− 45	19	..	..	Victoria, B.C.

* For Indian stations a day of rain is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

HONG KONG.—Prevailing wind direction E, mean speed 13·4 mi/hr.

ADELAIDE.—Only 2 cooler Januaries in the past 65 years.

PERTH.—Prevailing wind direction S., mean speed 13·8 mi/hr.

WELLINGTON.—Prevailing wind, direction S.

SUVA, FIJI.—Prevailing wind direction variable. 6 days with thunder heard.

GRENADA, W.I.—Prevailing wind direction NE.

										ADELAIDE :—
59·5	40	48	4·0	0·50	13	− 11	6	9·6	67	Dec. 1921.
55·9	27	55	4·5	22·65	575	+ 43	100	7·3	60	Year 1921.

Reference Table.—Climatological Table for the British Empire.

STATIONS.	Lat.	Long.	Height above M.S.L.	Hours of Observation.*	AUTHORITY.	Period of Normals.		
			Ft.			Pressure.	Temp.	Rainfall.
London, Kew Obsy	51°28′N	0°19′W	34	9, 15, 21	Meteorological Office, Air Ministry, London.	'71-'15	'81-'15	'81-'15
Gibraltar - -	36° 6′N	5°21′W	53	†7,13,21	Colonial Secretary, Gibltr.	'91-'15	'76-'19	'52-'19
Malta - -	35°53′N	14°28′E	185	†7, 18	Meteorological Office, Air Ministry, London.	'83-'19	'53-'65 '04-'19	'53-'19
Sierra Leone -	8°29′N	13° 9′W	224	9, 17	Principal Medical Officer	'91-'20	'75-'20	'47-'51 '75-'20
Lagos, Nigeria -	6°22′N	3°28′E	13	9	Surveyor-General -	'91-'15	'86-'00 '06-'15	'86-'19
Kaduna, Nigeria -	10°32′N	7°25′E	2,088	9	The Secretariat, Kaduna -	'91-'20	'07, '09-'19	'04-'18
Zomba, Nyasaland	15°23′S	35°18′E	3,100	9, 21	Director of Agriculture -	'92-'16	'92-'16	'92-'16
Salisbury, Rhodesia	17°48′S	31° 5′E	55	8	Hydrographic Engineer -	'98-'03 '07-'20	'98-'03 '07-'20	'97-'20
Cape Town -	33°56′S	18°29′E	40	8½,12·46	H.M. Astronomer - -	'41-'15	'42-'14	'41-'13
Johannesburg -	26°11′S	28° 4′E	5,925	8½	Chief Meteorologist, Pretoria	9 yrs. '04-'13	'04-'19	'88-'13
Mauritius - -	20° 6′S	57°33′E	181	hourly	Royal Alfred Observatory	'61-'19	'61-'19	'61-'19
Bloemfontein -	29° 7′S	26°13′E	4,550	8½	Chief Meteorologist, Pretoria	'70-'84	'81-'99 '03-'06	'78-'99 '03-'13
Calcutta, Alipore Observatory.	22°36′N	88°23′E	21	10, 16	Director-General of Observatories, Simla.	'89-'10	'78-'10	'78-'10
Bombay - -	18°54′N	72°49′E	37	6,10,14, 16, 22	Do. do.	'89-'10	'78-'10	'78-'10
Madras - -	13° 4′N	80°14′E	22	10, 16	Do. do.	'89-'10	'78-'10	'78-'10
Colombo, Ceylon -	6°54′N	79°53′E	24	‡9½, 15½	Surveyor-General, Colombo	'52-'16	'52-'16	63yrs. '52-'17
Hong Kong - -	22°18′N	114°10′E	109	hourly	Director, Royal Obsy. -	'84-'13	'71-'10	'84-'13
Sandakan - -	5°49′N	118°12′E	—	9	Principal Medical Officer -	—	'79-'95 '05-'20	'79-'95 '05-'20
Sydney - -	33°51′S	151°13′E	133	9,15,21	Commonwealth Meteorologist, Melbourne.	'59-'19	'59-'19	'59-'19
Melbourne - -	37°49′S	144°57′E	115	9,15,21	Do. do. - -	'58-'19	'56-'19	'56-'19
Adelaide -	34°56′S	138°35′E	140	9,15,21	Do. do. - -	'57-'18	'57-'18	'39-'19
Perth, W. Australia	31°57′S	115°51′E	197	9,15,21	Do. do - -	'85-'19	'97-'19	'76-'19
Coolgardie - -	39°57′S	121°10′E	1,389	9, 15	Do. do. - -	'97-'19	'97-'19	'93-'19
Brisbane - -	27°28′S	153° 2′E	125	9,15,21	Do. do. - -	'87-'19	'87-'19	'52-'19
Hobart, Tasmania	42°53′S	147°22′E	177	9,15,21	Do. do. - -	'85-'19	'71-'19	'41-'79 '82-'19
Wellington, N.Z. -	41°16′S	174°46′E	10	9	Meteorological Office, Wellington.	'65-'17	'69-'87 '94-'17	'65-'17
Suva, Fiji - -	18° 8′S	178°26′E	20	9	Superintendent, Department of Agriculture.	'86-'16	'86-'18	'86-'18
Kingston, Jamaica	17°55′N	76°12′W	24	7, 15	Government Meteorologist	'80-'99 '07-'18	'80-'99 '07-'18	'70, '72-'18
Grenada, W.I. -	12° 3′N	61°45′W	509	9, 18	Observer, Richmond Hill -	'76-'15	'87, '91-'18	'87, '91-'18
Toronto - -	43°40′N	79°24′W	379	8, 20	Director, Meteorological Service of Canada.	'00-'18	78 yrs.	70 yrs.
Winnipeg - -	49°53′N	97° 7′W	760	7, 19	Do. do.	'00-'18	45 yrs.	'75-'14
St. John, N.B. -	45°17′N	66° 4′W	118	9, 21	Do. do.	'02-'18	45 yrs.	'61-'10
Victoria, B.C. -	48°24′N	123°19′W	230	5, 17	Do. do.	'00-'18	29 yrs.	'81-'10

* Local or zone time. † Mean max. temp. refers to period 7h. to 18h., mean min. temp. 18h to 7h.

‡ Cloud amount mean of 7h., 9½h., 15½h.

Changes in Climatological Table since January 1920—

Gibraltar. From Sept. 1921 the mean max. temp. referred to period 7h. to 18h., mean min. temp. 18h. to 7h.

Malta. From May 1921 the mean max. temp. referred to period 7h. to 18h., mean min. temp. 18h. to 7h., and the hours changed to 7h. and 15h., June 7h. and 16h., Oct. 7h. and 18h., July, height changed to 185ft.

Lagos. Hours changed in July 1921 to 9h.

Kaduna. Revised pressure normals adopted in January 1922.

Salisbury, Rhodesia. First included in May 1920.

Colombo, Ceylon. For mean wet bulb and humidity hours changed in July 1920 to 9½h. and 15½h.

Sandakan. First included in May 1921.

Wellington. In Sept. 1920, height changed to 9 feet.

Suva, Fiji. In March 1921, height changed to 20 feet.

Winnipeg. Replaced Fredericton, N.B. in July 1920.

Sierra Leone & Australian Stations. Revised normals adopted in January 1922.

(*Continued from p.* 169.)

in a north-easterly direction. By the morning of the 13th the High was established off the west coast of Ireland and a trough of low pressure extended over the North Sea and Central Europe, so that the whole of western Europe was flooded with air drawn from Polar regions. The maximum temperature at Kew Observatory fell from 76° F. on the 12th to 53° F. on the 14th. On the morning of the 14th, the High was situated over the North Sea and a shallow trough extended over Ireland. The weather was generally cool with occasional rain in most districts, sleet being reported from Dombaas in Norway. From the 16th to the 21st a High over the Azores and a succession of depressions passing east over Ireland gave a westerly type of cool, unsettled weather to north-west Europe, while in a "flat" area of low pressure in Central Europe heavy rain fell locally.

Heavy snowfalls occurred on the Bavarian mountains over the week-end June 17th-18th, and out of two climbing parties totalling seven persons, five lost their lives.

On the 21st the Azores High had moved further east and higher temperatures and fine weather were experienced in southern England and France, the temperature at Bordeaux reaching 90° F. A depression which appeared on the morning of the 22nd off the Hebrides moved slowly across Scotland and reached Denmark by the morning of the 26th; then it went slowly northwards, being centred in the north of Norway at the end of the month. This slow-moving depression brought considerable rainfall to the whole of north-west Europe, including northern France.

Extreme heat was being experienced in Geneva in the second week of the month and owing to the melting of the snow the lake overflowed its banks in many places. On the 20th it was reported that owing to the flooding of the principal pumping machinery there was a water shortage in the town.

R. A. W.

FOLLOWING a period of drought, violent storms occurred in south-eastern Europe. On the 20th a severe thunderstorm broke over Sofia, causing much damage. There was little or no loss of life, but ten thousand persons were estimated to be homeless. Three days later a violent storm with torrential rain destroyed the Transylvanian village of Bistritza and resulted in about twenty deaths.

On the 1st severe hailstorms which destroyed the crops in certain parts were reported from Algeria.

The amount and distribution of Indian rainfall during the month was satisfactory except in Katiawar, southern Hyderabad and southern Madras, where it was deficient. The monsoon was normal, and there were no storms in the Bay of Bengal.

A very severe gale occurred over northern New Zealand on the night of May 31st and continued until June 3rd. The s.s. *Wiltshire* was wrecked on Great Barrier Island, and the crew were rescued with great difficulty.

A message received on the 24th stated that south-west Japan was suffering from a drought such as had been unknown for forty years. Rice cultivation was being abandoned in many districts.

It was reported from Toronto on the 24th that a destructive wind storm had been experienced from eastern Saskatchewan to the Ontario boundary. Severe damage was done along the whole track of the storm and some lives were lost.

A report issued by the United States Weather Bureau on the 7th stated that temperatures in the cotton belt during the first week of the month were below normal. Rainfall was heavy in many localities, and the state of the crop was on the whole rather unfavourable. On Sunday, June 12th, the region between Ohio and Massachusetts was visited by an extraordinarily violent storm. In New York the afternoon was brilliantly fine, and the storm came without warning. Although lasting barely half an hour damage and loss of life were caused to an extent without parallel in the history of the city. The storm appears to have been a complex system of tornadoes and waterspouts with violent thunder and lightning; the base of the clouds was estimated to be only a few hundred feet above the ground. The maximum wind speed was believed to be 100 miles per hour. Buildings were unroofed and large trees and sky signs blown about. The wind vortices sucked up all kinds of objects. At least 75 persons were killed and hundreds injured, City Island and the adjacent parts of Long Island Sound being the scene of the greatest number of casualties. The damage at Boston was estimated at a quarter of a million sterling, and many other towns were flooded. The important fruit crop of the Hudson and neighbouring valleys was entirely destroyed. On the same day the breaking of the river bank at San Salvador, in Central America, after several days of exceptional rain, destroyed part of the city. There were numerous casualties and two thousand persons were rendered homeless.

The chief feature of Argentine weather during the first half of the month was the prevalence of unsettled conditions. On the 15th a well-marked depression lay over the River Plate region accompanied by rain, with strong winds on the coast. Snow fell further west, and in the southern province of Chubut low temperatures were experienced, 9° F. being recorded at Sarmiento on the 13th. Fine, settled weather is usual in this month, and the mean pressure map shows a belt of high pressure from the South Pacific to the South Atlantic Oceans, crossing South America between 25° and 40° S. Lat.

The Portuguese naval airmen making their transatlantic flight arrived at Rio de Janeiro on the 17th, having flown a distance of 280 miles from Victoria. The weather was unfavourable with some rain and mist and poor visibility.

The special message from Brazil states that in the northern region the rainfall of the month was on the average 90 mm. above normal, several stations having over 200 mm. excess. Severe floods occurred in the Amazon Basin and in Parahyba State. Rainfall was also above average in the central and southern districts, and the cane and cotton crops have suffered generally. Temperature was on the whole in excess of normal. Violent storms occurred at the end of the month in the extreme south of the country.

The rainfall of the month of June was generally below the average, considerable areas in the southern half of Ireland and the centre of England receiving less than half the average. Areas with excess rainfall occurred mainly in the Western Highlands of Scotland. Less than 25 mm. (1 in.) for the month was recorded over a band from Sidmouth to Hull, including the greater part of the English Midlands, but hardly anywhere else. In the English Lake District and in Invernessshire falls of about 250 mm. (10 in.) were recorded very locally. In Ireland the fall was generally between 25 and 50 mm., exceeding that amount in the west and north.

The general rainfall expressed as a percentage of the average, was; England and Wales, 64; Scotland, 102; Ireland, 69; British Isles, 77.

In London, Camden Square, the mean temperature was 60·7° F., or 0·5° F. above the average; the duration of rainfall, 15·9 hours; and the evaporation, 3·36 inch.

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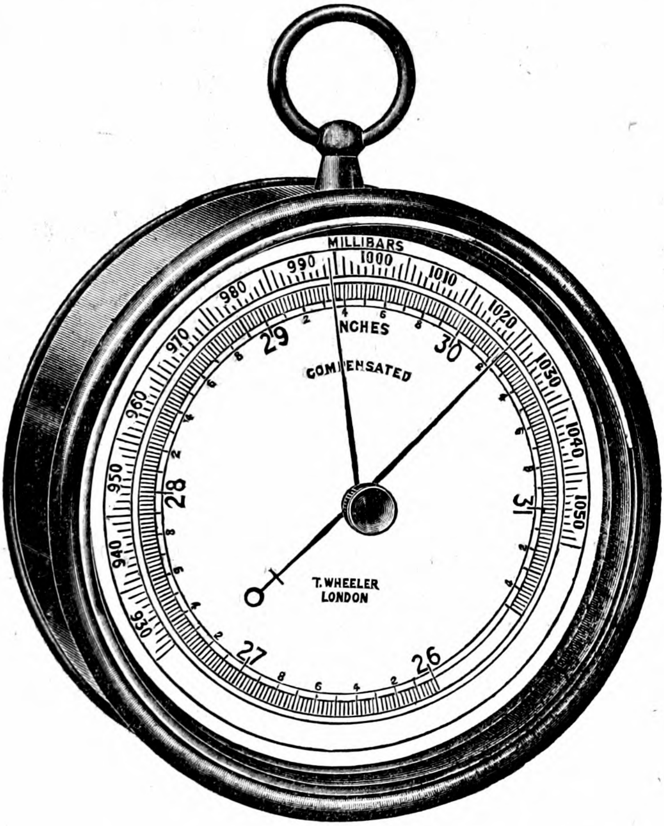
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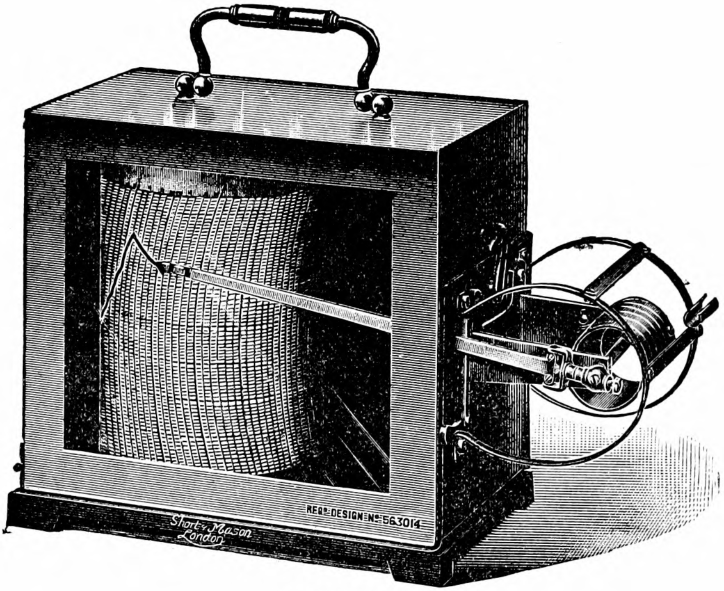

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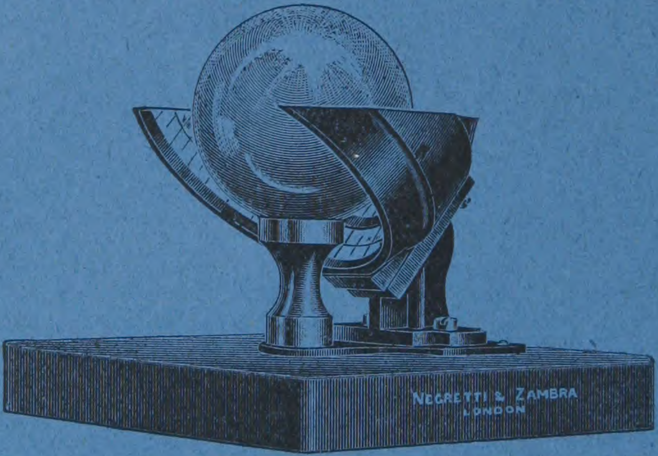

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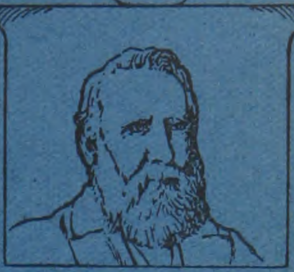
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AUGUST, 1922.

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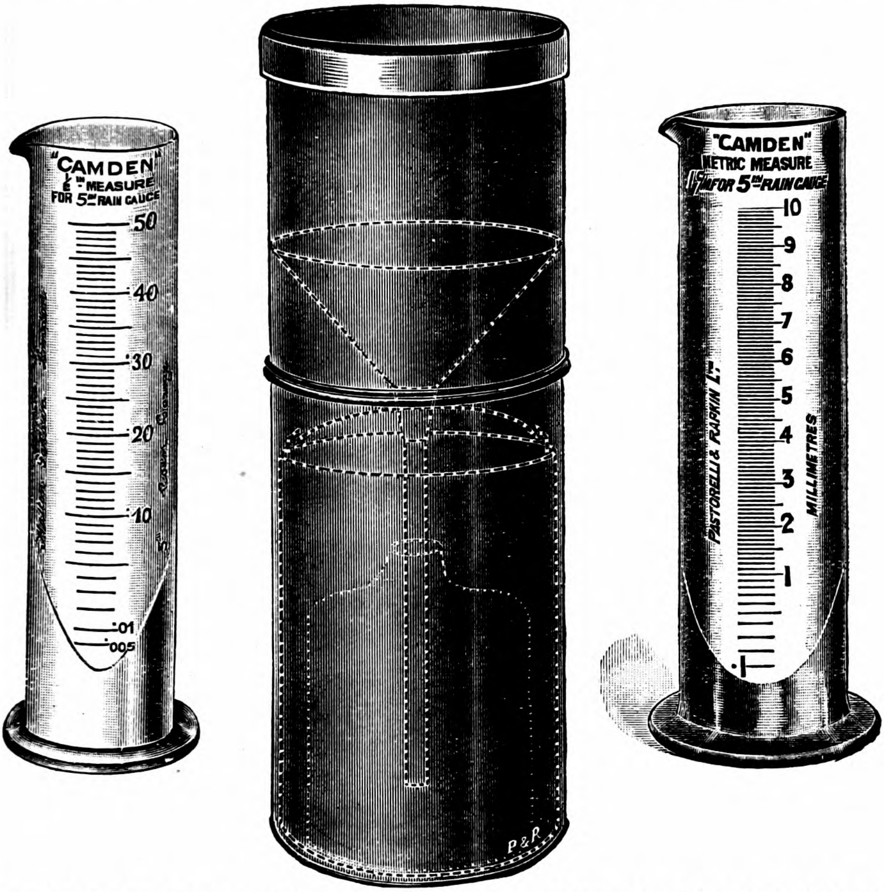

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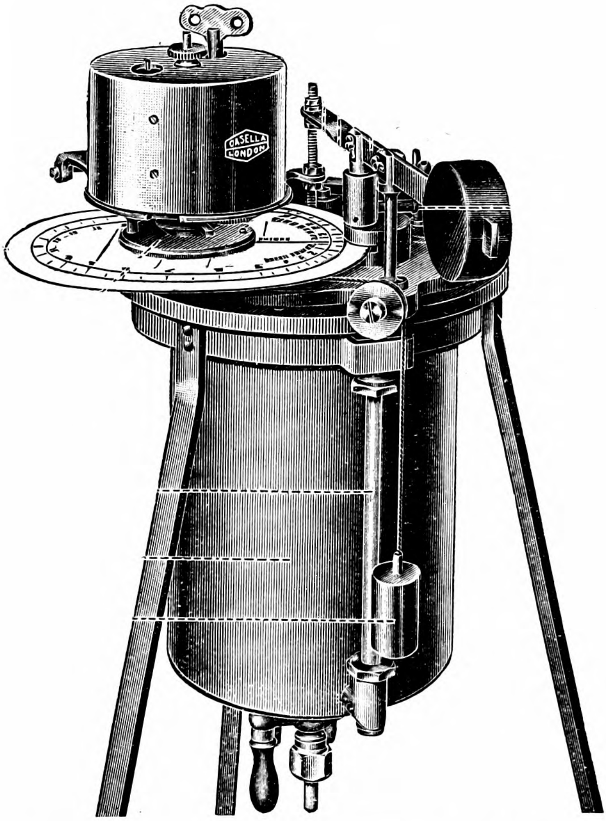

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The Cold Spell in May.

By C. E. P. Brooks, M.Sc.

THE quasi-periodic occurrence of a cold spell lasting for a few days early in May is a well-known popular belief, both in the British Isles and on the continent of Europe. The average date of its occurrence is said to be about May 12th, and on the Continent three " Saint Days," those of St. Mamertius, St. Pancras and St. Gervais, falling on May 11th, 12th and 13th respectively, are popularly known as the *Eisheiligen*, or " Ice Saints." This cold spell appears to play an important part in Messrs. Horner and Robertson's method of forecasting, as set out in their recent work *Simple Weather Forecasting for Everyone.*

If there is any approach to periodicity in the occurrence of such a cold snap, it should be readily recognisable in the mean temperatures for each day of the year, averaged over as long a period as possible.

That this is hardly the case is shown by the table of mean daily values for May 5th to 20th.

In the *Temperature Tables for the British Isles* the mean daily temperatures at Valencia, Aberdeen, Kew and Falmouth were represented by smooth curves (normal curves) calculated from the first two terms of the Fourier series, and the departures of the daily means from the smooth curves were considered. At Valencia the normal curve during May represents the observations very closely; but at Falmouth, Aberdeen and Kew there

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were periods from the 16th to 23rd, 14th to 22nd, and 13th to 23rd respectively when the daily temperatures were 2° to 4° F. below the normal curve. This means that about the third week in May the regular spring rise of temperature was checked, but it does not necessarily mean that there was a periodic occurrence of frosts about that date.

Mean Daily Values for May 5th to 20th.*

May.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.
Greenwich ° F	50·4	50·9	51·1	50·7	51·0	51·3	51·7	52·5
Kew - ° F	49·9	51·1	50·9	51·3	51·1	50·8	51·0	52·5
Berlin ° F	51·6	54·7	54·0	54·7	55·0	55·0	54·9	56·1
Vienna - ° F	57·4	57·2	59·0	59·9	60·1	59·9	59·4	60·3

May	13th.	14th.	15th.	16th.	17th.	18th.	19th.	20th.
Greenwich ° F	52·7	52·8	52·8	53·2	52·9	53·1	53·2	53·6
Kew - ° F	52·7	52·4	52·1	51·8	51·9	52·5	51·8	52·1
Berlin - ° F	56·8	56·8	56·8	57·0	57·6	58·1	57·4	56·8
Vienna ° F	60·0	59·9	60·6	60·8	60·6	61·3	61·3	61·7

* Greenwich, 1841–1905 : *Reduction of Greenwich Meteorological Observations*, Part 4, 1906; Kew, 1871–1900 : Off. No. 154. *Temperature Tables for the British Islands*, London, 1902. Berlin, 1808–1907. Behre, O. *Das Klima von Berlin*. Berlin, 1908. Vienna, 1775–1874. *Jahrbuch K. K. Zentral-Anstalt für Meteorologie*, 47, 1910.

C. F. Marvin, who investigated irregularities in the annual march of temperature[1] in the eastern United States, concluded that these irregularities, some of which are popularly known there as the " January Thaw," " May Freeze," " Squaw Winter," " Indian Summer," etc., are not periodic, but are merely accidental irregularities in the curve, which will disappear when we have a long enough series of observations.

Allowing, then, that the May frosts are not strictly periodic, can it be said that there is a definite cold spell occurring somewhere between, say, the middle of April and the middle of June, in each year, to which the term can be applied? Two answers are possible, according to our way of regarding the problem. If we regard the sequence of weather types, which govern alternations of warm and cool weather, as independent of the precise season, the answer is negative. If, on the other hand, we regard this sequence as intimately connected with phenomena such as the break-up of ice, which by their nature recur at about the same time each year, then there will be a series of phenomena such as "May frosts" which will be recognisable each year, and to which definite names can be given.

---

[1] *Monthly Weather Review*, 47, 1919, p. 544. Washington, D.C. (with Bibliography).

The latter position is taken up by Horner and Robertson, who state that the May cold spell is "quite certainly due to the breaking up of the ice, which flows into the North Atlantic between April and June, and which is generally found in the north-western portion of the ocean north of 38° N. and west of 38° W." One gathers that this outbreak of ice is sudden, and is followed almost immediately by cold weather, due to winds coming directly off the ice-pack.

So far from being "quite certain," this position is untenable when a few physical facts are considered. In the first place the outbreak of ice is not sudden, but the amount found on or near the Newfoundland Great Banks usually increases gradually from January or February until May or June, and subsequently declines equally gradually. In the second place, a careful study of the charts compiled by the late Captain Hepworth for the years 1903 to 1912[1] fails to show any relationship between the amount of ice and the temperature over the British Isles at the same time or for a month or two later.

Thirdly, the distance from Newfoundland to England is nearly 2,000 miles, while the average speed of the Gulf Drift over this distance is under 10 miles a day. Since it is impossible for any temperature effect to be propagated over such a distance by wind alone, and the cooled water takes at least six months to make the journey, we cannot expect any fall of temperature due to this outbreak of ice until the following autumn. On the Continent it should be later still, but we have seen that the May cold snap occurs there slightly earlier. It is even found in Russia, where it occurs a day or two earlier even than in Western Europe. Among other investigations we may refer to the work of K. Almstedt,[2] who concluded that the immediate cause of the cold spell is a régime of northerly winds due to the establishment of an area of high pressure over the North Sea or eastern North Atlantic, and he suggests that the ultimate cause is probably the difference in the rates of warming of land and sea. Similar cold spells in spring are in fact met with in temperate regions in all parts of the world, sometimes under circumstances which render it impossible that polar ice can play any part in their occurrence.

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[1] *Geophysical Memoirs*, Nos. 1, 10. M.O. 210*a* and 210*j*.

[2] *Die Kalterückfalle im Mai und Juni.* Diss. Gottingen, 1913.

Official Publications.

Professional Notes No. 29. On the Formation of Thunderstorms over the British Isles in Winter. By E. V. Newnham, B.Sc. Royal 8vo, 4 pp. Price 6d.

THUNDERSTORMS are rare in winter over eastern England, but they occur sometimes in the west and north. In this note cases of thunderstorms occurring in January during the 8 years 1900–7 have been investigated, with a view to tracing the paths of the air which gave rise to the storms.

For the formation of thunderstorms in summer instability over a height of several thousand feet, caused by a rapid fall of temperature with height, is essential. The author assumes that in winter the same unstable conditions are necessary, but that, solar radiation being relatively feeble, the instability is brought about by the heating by the warm ocean of the lower layers of a cold current of air. He, therefore, expects storms to occur in air which has come from a very cold region and subsequently crossed a considerable stretch of ocean. Investigation shows that this is very frequently the case. Of the thunderstorms occurring in January during the years 1900–4 with south-westerly or westerly winds, in 25 cases the origin of the air was in high latitudes, and in only one case was the origin of the air in low latitudes.

The trajectories of air accompanied by thunderstorms, and in some cases those of air unaccompanied by storms, are drawn for January of each of the years 1900–4 in Figures 1–5.

Particulars of Meteorological Reports issued by Wireless Telegraphy in Great Britain and the Countries of Europe and N. Africa. Royal 8vo, 84 pp. Price 2s. 6d.

THIS publication gives in a concise form details of the meteorological reports broadcasted by wireless telegraphy from both the central and local offices in Great Britain and from the central offices in other countries. The particulars are arranged under the different countries and give details as to the transmitting station, call signal, wave-length, times of issue of the messages, the names and positions of the observing stations, the codes used in the messages, &c. The pamphlet concludes with the specification of the International Code for Meteorological Messages.

The Wireless Weather Manual. Royal 8vo, 24 pp. Price 9d., postage 1d.

MANY people who possess wireless receiving sets are picking up meteorological messages. This pamphlet is intended to explain to the amateur how he can interpret these messages and utilise them to make a forecast of the coming weather in his own locality. As well, therefore, as details of the issues broadcasted by wireless from the Air Ministry, which include synoptic reports, forecasts, aviation reports and forecasts, and a "general inference," a short explanation is given of how to make synoptic charts from the data given in the messages. Using the data given in the synoptic report issued by wireless telegraphy at 2h, 8h or 19h a weather map can be drawn one hour after the observations are taken.

The Royal Meteorological Society.

A MEETING of the Royal Meteorological Society was held on Monday, July 24th, in the rooms of the Royal Society, Edinburgh, Dr. C. Chree, F.R.S., President, in the Chair. This was the second meeting to be held in Edinburgh since the amalgamation of the Scottish Meteorological Society with the Royal Meteorological Society in January, 1921.

The following papers were read and discussed :—

C. K. M. Douglas, B.A.—Observations of Upper Cloud Drift as an Aid to Research and to Weather Forecasting.

The paper discusses the wind near the top of the troposphere in different stages of the life-history of a cyclone, following on recent researches under Prof. V. Bjerknes in Norway. The conclusions are based on a large number of observations of high clouds and also on observations by other methods, though these are scarce in really disturbed weather. The pressure distributions aloft, disclosed by the upper winds, are considered in relation to temperature, as the pressure at considerable heights is largely determined by the temperature of the column of air underneath. The results show that there is a complete lack of symmetry in the temperature distribution over a cyclone in its earlier stages, with a great contrast in the temperature of the whole troposphere between the "polar" and "equatorial" currents. When the cyclone has reached its final stage, in which it normally becomes stationary and fills up, the distribution of temperature and wind in the upper air approaches to symmetry round the centre, and the easterly current on the north side often extends throughout the troposphere. The conclusions in the paper are supported by direct observations of temperature when these are available. With regard to weather forecasting, it is found that no simple rules can be drawn up, as the changes in the wind at considerable heights follow rather than precede those near the surface. Observations of high cloud motion are, however, a valuable supplement to other information, as they throw light on the temperature distribution in the troposphere as a whole.

J. S. Dines, M.A.—Note on the Effect of a Coast Line on Precipitation.

The paper discusses a convergence effect which will be found over a coast line when the wind blows along the coast, the low pressure being over the sea and the high pressure over the land. The convergence is due to the greater incurvature which occurs in winds over the land than over the sea. An example is worked out and it is found that under favourable conditions an upward current of 15 feet per minute may be produced over a strip of the earth's surface extending 5 miles on each side of the coast line. An example of precipitation which may have been caused by this effect is given. A somewhat similar effect occurs wherever the pressure gradient varies along a line perpendicular to the isobars, and the following rule is deduced: " In any area where the pressure gradient increases towards the ' High ' there will be rising air."

A. E. M. Geddes, D.Sc. and G. A. Clarke.—Note on Turbulence, as exhibited by Anemometer Records, Smoke, and Cloud Formation.

The first section of the paper deals with the phenomenon of turbulence and eddy-motion. The effect of this eddy-motion is shown near the surface by the records from a pressure tube anemometer. The turbulence and consequent eddy-motion are seen to depend largely on the nature of the surface over which the air current is travelling. Especially is this the case in so far as eddies affect the direction of the wind. The presence of eddies higher up is rendered visible by the behaviour of smoke from tall chimneys and by the manner in which this smoke is raised and at the same time dissipated laterally. Higher up cloud of the stratus order is formed. These smoke eddies and clouds occur when there is little or no convection due to heated air and therefore their appearance and formation is evidently in accordance with Taylor's theory of eddy-motion. The formation of eddies at the junction of two currents of different temperature and hence of different density is demonstrated by photographs showing the fragments of cloud which form *below* the base of a line-squall or similar cloud.

The second section of the paper describes that interesting variety of cloud intermediate between the normal cirrus and cirro-cumulus types. The changes that this cloud undergoes have long proved a puzzling phenomenon to cloud observers. The change of the cirro-cumulus type, which is generally regarded as a water-droplet cloud, into the ice-crystal structure of true cirrus is only to be expected at the high altitudes and consequently generally very low temperatures of the levels where this cloud is found, but the great frequency with which the reverse process is to be observed calls for some explanation. A number of lantern slides showing these changes and different varieties of the " cirro-macula," as the cloud is termed, were shown, and the Meeting was invited to offer suggestions upon the point in question.

An Exhibition of representative meteorological instruments was on view in the rooms of the Royal Society.

Correspondence.

To the *Editors, Meteorological Magazine.*

Cloud Nomenclature.

Dr. C. F. Brooks in his proposed definition of cirro-cumulus clouds (*Met. Mag.* 1921, page 158) speaks of these as " composed of ice particles," and says that they produce " no diffraction colours near the sun or moon." Also " at times the tops of cirrus tufts or of cirro-stratus sheets are capped with cirro-cumulus." Dr. Simpson deals effectively with one aspect of the question (*Met. Mag.* 1921, page 219). One would judge that Dr. Brooks wishes to include what has hitherto been called cirro-cumulus in his new definition of alto-cumulus and that the new name is really to be applied to flocculent cirro-stratus. I have never seen orthodox cirro-cumulus capping any sort of cirrus, though it often appears in company with alto clouds (*see*, however, Clayden's *Cloud Studies*, page 50 and Plate 18, where cirro-cumulus and " cirro-stratus " are shewn in one cloud mass. Judging by the plate some observers would call the "cirro-stratus " alto-stratus). Who has yet proved that cirro-cumulus is composed of ice-particles? Johnstone Stoney made a fine attempt (" On the Cause of Iridescence in Clouds," *Sci. Trans. R. Dublin Soc.* III. 1887); but he assumes, like others, that " at the elevation in our atmosphere at which these delicate clouds are formed, the temperature is too low, even in midsummer, for water to exist in the liquid state; they consist, in fact, of tiny crystals of ice, not of little drops of water." And he goes on to argue that the iridescence is caused by the fluttering—in an artificial-looking way—of tiny ice-flakes. Herschel in his *Meteorology* describes an observation of his own of iridescence in which " the coloured bands grew broader and the tints very strong and a tendency to form a corona about the sun was perceived." This seems to imply a definite relationship between cirro-cumulus and alto-clouds. The argument in Simpson's " Coronæ and Iridescent Clouds " (*Q.J.R.Met. Soc.*, Oct. 1912) seems to me conclusive that cirro-cumulus is more nearly related to alto clouds than it is to cirrus. It does not seem necessary to assume even that the temperature of the cloud particles in cirro-cumulus is excessively low. It is conceivable that super-cooled vapour might condense on ascending fine dust much warmer than itself. Nevertheless, even if all this be granted, it seems a pity to take its name away altogether, and still worse to give that name to another sort of cloud. If the " cirro " is to be dropped then rather than substitute " alto " let some distinctive prefix (say " scombo ") be adopted.

R. SUTTON.

Kimberley, South Africa, April 24th, 1922.

A Modification of the Green Flash.

AFTER 8 p.m. (G.M.T.) this evening the sun was intensely coloured, more vermilion than orange-red. From here it touched the skyline across the main Brighton road valley, on hills nearly two miles distant, fringed with trees. There happened to be one break forming a sharp notch and after the rest of the sun had disappeared below the tree tops a small portion remained visible here. The light first grew yellow, then through yellowish green to green. Instead of this vanishing in the fraction of a second, as usual, it lingered for some seconds, probably three to five. This was so marked that I wondered if by chance a road lamp was visible through the notch. That, however, was not so, for the light suddenly vanished in the usual way.

J. EDMUND CLARK.

Purley, Surrey, July 10th, 1922.

Steaming Roads.

IN this connection it may be worth recording that on July 4th I left Church Stretton for Shrewsbury by the 9.45 train G.M.T. Up to 9.20 G.M.T. it had been raining steadily and heavily : it then cleared and the sun shone brightly. As we travelled I noticed in one or two spots white steam rising from the furrows in a ploughed field; not all over the field, but here and there.

ELEANOR M. TAWNY.

14, *Northmoor Road, Oxford.*

An exceptional Lunar Corona.

AFTER a splendid afternoon and evening, at Street, Somerset, Monday, August 7th, a slight shower fell at midnight (G.M.T.). Half an hour later the moon (within a few hours of full) was practically clear against a very slightly opalescent sky. This was so slight that it would have escaped notice had it not been that the moon was surrounded by a most brilliant corona. Outside the bright, nearly white section the orange red band was succeeded by a wider one of intense peacock blue, which in turn merged into a second much fainter one of red, in which the orange shade was less pronounced. This ended in the practically clear sky already described.

The colours of each band showed very little variation in tint as one passed outwards.

The rings from the moon outwards were in the proportions of three, two, three, two lunar diameters. If anything the reds were slightly under two, the blue perhaps as much over three. Hence the full diameter was 10° to 11°.*

During the five minutes, or more, of the watch the colours continued bright. Later on more rain fell, culminating in a torrential ten minutes downpour about 5.15 a.m.

J. EDMUND CLARK.

Craigellachie, 41, *Downscourt Road, Purley, Surrey, 9th August* 1922.

NOTES AND QUERIES.

The Probable Error of a Mean Value: Correction for Increase in the Number of Terms.

MR. A. MACDONELL, of Cann, Shaftesbury, who has been investigating rainfall statistics writes to point out that the formula by which estimates of the probable error of a mean value covering a number of years' observations may be kept up to date is not to be found in the text books.

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* It is computed that the size of the droplets producing this corona was approximately ·01 mm.—Ed. M.M.

The mean for, say, $n+1$ years is different from that for n years, the residuals are different, the squares of the residuals are different, and it is tedious to make the long calculation of the probable error *ab initio*. Mr. Macdonell's method saves all this labour; it may be summarized as follows :—

Let M_n be the mean of n quantities $x_1 \ . \ . \ . \ x_n$ so that

$$M_n = \Sigma_1^n \, x/n$$

and let σ_n be the standard deviation of the x's, so that

$$\sigma_n^2 = \Sigma_1^n \, (x - M_n)^2/n$$

then the probable error is E_n where

$$E_n = \cdot 6745 \, \sigma_n/(n-1)^{\frac{1}{2}}$$

When the values of M_n, σ_n and E_n have been computed an additional value of x may become available, for example, when a series of observations covering n years is extended by the addition of another year.

In that case, the first step is to compute a, the correction to be applied to the mean value, by the formula

$$a = (x_{n+1} - M_n)/n + 1$$

Then we have

$$M_{n+1} = M_n + a$$

together with the accurate relations

$$\sigma^2_{n+1} = \frac{n}{n+1} \sigma^2_n + na^2$$

$$E^2_{n+1} = \frac{n-1}{n+1} E^2_n + \cdot 4550 a^2$$

and the more useful approximate relations

$$\sigma_{n+1} = \left(1 - \frac{1}{2n}\right) \sigma_n + \frac{n}{2} \frac{a^2}{\sigma_n}$$

$$E_{n+1} = \left(1 - \frac{1}{n}\right) E_n + \frac{1}{4} \frac{a^2}{E_n}$$

The following example has been given by Mr Macdonell. The mean rainfall at Shaftesbury for the 39 years, 1881–1919, is 32·57, and the probable error ± 0·54. The mean for 40 years is 32·55, so that a is 0·02 and the probable error ± 0·53. The rainfall for 1921 was only 18·31 ins., so that the mean for 41 years is 32·21, a is $-$ 0·34, and the probable error ± 0·57.

The calculation of the means and of the probable errors of the means may be made very simply by the method shown below; but such a method is obviously liable to accumulated error, and would be undesirable for the calculation of a long series of additional values.

	Mean.		Probable Error.	
39 years	**32·57**			**0·54**
1920		31·76	$\frac{1}{39}$th	−0·01
40*a* -		−·81	$\frac{1}{4}\frac{a^2}{E}$	+0·00
a -	−0·02			
40 years -	**32·55**			**0·53**
1921 - -		18·31	$\frac{1}{40}$th	−0·01
41*a* - -		−14·24	$\frac{1}{4}\frac{a^2}{E}$	
a -	−0·35			+0·06
41 years -	**32·21**			**0·58**

It is curious that the probable error of the mean for 41 years should be greater than that for 40 years. Evidently the occurrence of such a remarkably small rainfall in 1921 makes the validity of previous estimates of the true mean open to question.

The Sound of the Oppau Explosion.

It will be remembered that the investigation* of the audibility in England of the explosion at Oppau, near Mannheim, on September 21st, 1921, led to a negative result. Two important papers dealing with the region of audibility of this explosion have now been published, the first† by Prof. A. de Quervain, President of the International Commission for Investigations on the Sound of Explosions, the other‡ by Herman Zierl of the Bavarian Meteorological Service.

From the reports that have been collected it appears that there was an inner zone of audibility within 100 km. of Oppau and an outer zone generally between 200 and 300 km. from Oppau and extending from South Prussia through Saxony and Bohemia to Switzerland.

As to the meteorological situation we learn that there was a ridge of high pressure over Germany and France so that the surface winds were irregular, but at 2,000 metres and upwards there was a general current from the west. De Quervain considers that this upper wind was strong enough to account for the refraction of the sound waves and to provide a general explanation of the position of the region of audibility.

A footnote on Professor de Quervain's article should be mentioned. Referring to the article in the *Meteorological Magazine,*

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* *Met. Mag.*, Vol. 56, 1921, p. 277.

† Zürich, *Ann. Schweiz. Met. Zentralanst*, 1920, Anhang 5, I.

‡ *Deutsches Met. Jahrb. Bayern*, 1921, E. I.

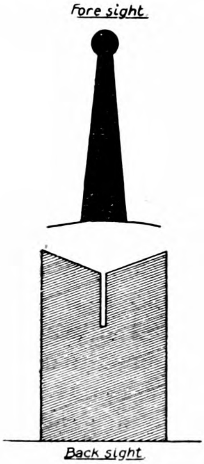
November, 1921, he points out that in the Swiss Yearbook for 1908 he put forward the theory in which the zone of abnormal audibility is ascribed to the distribution of wind in the upper atmosphere and applied it to the case of the explosion on the Jungfrau railway, so that his work preceded that of Fujiwhara, to which reference was made in the *Meteorological Magazine.*

A useful bibliography accompanies Zierl's paper. We notice, however, the omission of some of the recent work published in this country, especially of Mr. Miller Christy's detailed accounts of the audibility of continual gunfire during the war* and of Dr. Davison's investigation of the Silvertown Explosion.†

A new Theodolite Sight.

A PILOT balloon theodolite is always provided with sights fitted on the telescope which are used for " finding " the balloon before it can be seen in the telescope itself. The backsight is generally a " V " but in some patterns an " orthoptic " sight is used, *i.e.*, the observer has to look through a small hole. Of the two devices the former is probably the more satisfactory, but the acute angle of the " V " does not readily assist the eye in centering the foresight. The orthoptic sight, while affording some assistance to those whose eyesight is imperfect, has the disadvantage of cutting off a considerable amount of light, and, unless the eye is placed inconveniently near, the field of view is greatly restricted.

With a view to overcoming these difficulties the backsight shown in the accompanying drawing has been devised by Mr. H. W. Baker, mechanical assistant at Benson Observatory.



This backsight has a wide " V " of 150°, with a vertical slot cut in the middle of the " V." The slot has been found to be of great assistance in centering. The foresight** of the Mark B theodolite for which the new backsight was designed is a bead on the top of a short stem and the advantage of the slot in the backsight is that any lateral error in the position of the observer's eye is noticed at once as it allows light to be seen past the stem. In correct adjustment the bead rests at the bottom of the wide " V " and the the odolite is pointed so that the balloon is seen on top of the bead.

The new backsight has been found to be

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* *Q.J.R. Met. Soc.*, Vol. 42, 1916, p. 267; vol. 44, 1918, p. 281; vol. 45, 1919, p. 141.

† *Edinburgh, Proc. R. Soc.*, Vol. 38, 1918, pp. 115–29.

** Foresight and backsight are both drawn full size in the diagram. In use the distance of the foresight from the eye is about three times that of the backsight.

satisfactory under all conditions. With a larger sight-radius a foresight bead of greater diameter would be an advantage.

British Association for the Advancement of Science.

Hull Meeting, September 6–13th, 1922.

THE programme of the Meeting at Hull in September will contain a number of features of immediate interest to meteorologists. The Cosmical Physics sub-section of Section A (Mathematics and Physics), which embraces Meteorology, will join the Geography Section in a discussion on " Monsoons," and will also join the Economics and Agriculture Sections in one on " Weather Cycles in Relation to Agriculture and to Industrial Fluctuations." As arrangements stand at present, Dr. G. C. Simpson, F.R.S., will open the first discussion and Mr. G. G. Chisholm and Dr. H. Jeffreys will also speak. Sir William Beveridge will open the second discussion and speakers will include Dr. Simpson.

Papers to be read include one before Section A by Sir Napier Shaw probably on " Convection in the Atmosphere," one before Section B (Chemistry) by Dr. J. S. Owens on " Atmospheric Dust " and one before Section A by Mr. M. A. Giblett on " Some Recent Developments in Synoptic Meteorology." The latter will refer to a demonstration which will be given by the Meteorological Office, Air Ministry on the same lines as at the Meeting in Edinburgh last year (see *Meteorological Magazine,* October, 1921, p. 249) and recently at the Royal Agricultural Show, Cambridge (see *Meteorological Magazine,* July, 1922, p. 161). The main object of this demonstration will be to show how any private individual may intercept and utilise the weather information which is now being broadcasted by wireless telegraphy daily by European countries. A temporary wireless station will be installed in the Guildhall, Hull, and opportunities will be afforded to Members of the Association of seeing the whole process of the reception of coded messages and their transformation into weather maps, which will be exhibited together with forecasts based on them, on a large blackboard in the Reception Room. A " Local Daily Weather Report " will also be produced and copies will be posted in a number of places.

The " Meteorological Luncheon " will probably be held on Thursday, September 7th; details will be given in a notice displayed in the Reception Room during the early stages of the Meeting. M. A. G.

The Deep Sea Fishing Exhibition.

AT the invitation of the promoters, the Meteorological Office provided an exhibit at the Deep Sea Fishing Exhibition, held at the Royal Agricultural Hall from July 24th to August 5th, 1922. The aim was to place before the public the work of the Meteorological Office in its relation to the fisherman and his trade.

The exhibit consisted of diagrams, charts, publications and instruments. The main feature was a large blackboard on which the weather map for north-west Europe was drawn twice a day, the data being received by telephone from the Air Ministry. On two wings to the main board forecasts and explanations were displayed. The North Sea forecast was given special prominence. Considerable interest was shown by the public, the short lectures on the weather map being very popular.

Scientific Cruise from Bergen.

DURING May and June of this year a scientific cruise was made by the 28-ton motor-boat the *Armaner Hansen* of Bergen. The primary object of the cruise was to obtain data for the study of the temperature and density of the waters of the Atlantic. Professor Björn Helland-Hansen, of the Geophysical Institute, Bergen, was responsible for Oceanography; Professor D. Damas, of Liége University, for Marine Biology, and Mr. E. G. Calwagen, of the Meteorological Observatory, Bergen, for Meteorology. The expedition left Bergen on April 24th; the following ports of call give some idea of the route followed :—Ostend, Lisbon, Casablanca, Funchal (Madeira), Ponta Delgada (Azores), Ostend. Hydrographical and biological observations were taken at about 40 points. Kites were flown to obtain meteorological observations. The weather reports received by wireless telegraphy were utilised for the regular preparation of maps and forecasts.

Disaster to Mount Everest Expedition.

A DISASTER befell the Mount Everest Expedition on June 7th. While making the final effort to reach the summit the climbing party was overtaken by an avalanche and was carried down some distance by the falling snow. Most of the members of the party landed on a ledge and were unhurt, but seven of the porters were buried in a deep crevasse with most of the avalanche on top of them. All hands worked hard for some hours and six of the bodies were recovered. The expedition has been abandoned for this year.

Whirlwind at Worthing.

THE following note on a whirlwind at Worthing on April 27th has been sent to us:—

> A whirlwind struck Worthing at about 13 h. 10 m. on Thursday afternoon. Two boats were lifted into the air about 25 feet; one was carried a distance of 150 yards and thrown on the beach, being smashed to pieces; the other was carried a distance of 100 yards and thrown against a groine post and the side burst in.
>
> Nine boats in all were severely damaged, but as far as I can learn no other damage was done.
>
> After striking the boats the whirlwind passed along the beach in an easterly direction for about 300 yards, and then altered its course and went out to sea in a south-easterly direction. I lost sight of it in a heavy rain squall.
>
> E. J. SOUTHWOOD, C.O.

H.M. Coastguard Station, Worthing, April, 27th, 1922.

Meteorology in Poetry.

In *John o' London's Weekly,* July 1st, 1922, under the title *Where are the Songs of Summer,* Mr. Philip Tomlinson gives quotations from English poets.

There is very little with direct bearing on meteorology in these quotations. Perhaps the most interesting is from William Morris—

The summer night waneth; the morning light slips
Faint and grey 'twixt the leaves of the aspen, betwixt the cloud bars,
That are patiently waiting there for the dawn :
Patient and colourless, though Heaven's gold
Waits to float through them along with the sun.
Far out in the meadows, above the young corn,
The heavy elms wait, and restless and cold
The uneasy wind rises; the roses are dun;
Through the long twilight they pray for the dawn
Round the lone house in the midst of the corn.

In the same number of *John o' London's Weekly* a correspondent quotes from Childe Harold a good example of " Sound and Movement in Poetry."

" The sky is changed ! such a change ! O night,
And storm, and darkness, ye are wondrous strong,
Yet lovely in your strength, as is the light
Of a dark eye in woman ! Far along,
From peak to peak, the rattling crags among,
Leaps the live thunder! Not from one lone cloud,
But every mountain now hath found a tongue;
And Jura anwers, through her misty shroud,
Back to the joyous Alps, who call to her aloud !

> And this is in the night ! Most glorious night,
> Thou wert not sent for slumber ! Let me be
> A sharer in thy fierce and far delight—
> A portion of the tempest and of thee !
> How the lit lake shines—a phosphoric sea—
> And the big rain comes dancing to the earth !
> And now again 'tis black—and now the glee
> Of the loud hills shakes with its mountain-mirth,
> As if they did rejoice o'er a young earthquake's birth."

Fine poetry no doubt, but open to criticism as a scientific description of a thunderstorm.

Reviews.

J. Bjerknes and H. Solberg. *Meteorological Conditions for the Formation of Rain. Geofysiske Publ.*, Vol. II., No. 3. Kristiania, 1921. Size 12 × 9, pp. 60, 1 plate.

FREQUENT references have been made in the writings of Professor V. Bjerknes to a forthcoming publication on the *Meteorol gical Conditions for the Formation of Rain*, written by his son, J. Bjerknes, in collaboration with H. Solberg.

This paper, which is one of a series in which the Norwegian school of meteorologists is developing Bjerknes's theories, is of first class importance and it is not too much to say that it should be studied by all who wish to obtain an insight into the nature of weather changes in north-west Europe.

The material at the disposal of the authors has consisted of the observations at the close network of stations of the Norwegian Meteorological Service. It is remarkable how much may be learned from the combination of good cloud and wind observations with information as to the time of rainfall. Although the work is concerned throughout with conditions in the upper air, no direct use is made of balloon soundings either for winds or for temperature, so that it is on much the same footing as Shaw and Lempfert's *Life-history of Surface Air Currents.*

Amongst the lessons which the authors teach us perhaps the most far-reaching is the importance of regarding the cloud canopy over the country as a connected whole. The familiar representations of a cyclone with cirrus here, stratus there, and cumulus somewhere else are merely confusing. The newer scheme, in which attention is focussed on a single cloud sheet growing thicker and denser from front to rear, is easy to visualise and lends a new interest to every observation. The development of such a cloud sheet is evidence for the gradual thickening of a layer of warm moist air over a colder current We learn to appreciate the significance of tufted cirrus or mare's tails when we realise that the tuft is the cloud formed by the condensation in the turbulent warm current, and that the tail is the trail* of this cloud as it is scraped, so to speak, over the cold, stable and slow current below.

The detailed study of the development and disappearance of a *régime* of local showers and thunderstorms is of great importance. We learn how long the same air can remain over a small country like Norway, how moist air works its way inland from the sea, making progress during the day, and flowing back to a certain extent during the night until the land is covered by air warm enough and moist enough for local convection to produce rain. On the other hand the gradual invasion of the land by cold dry air under the influence of the general pressure distribution may also take several days and lead to the gradual displacement of the showery conditions by steady fine weather.

We can only hope that this work will find imitators in other countries so that the validity of the generalisations may be thoroughly tested.

F. J. W. W.

Notes d'Estudi. Servei Meteorologie de Catalunya. Barcelona, 1921–22. Size 8½ × 6.

Under the directorship of Dr. E. Fontseri the Meteorological Service of Catalonia is showing great activity. A series of pamphlets entitled *Notes d'Estudi* is now being published for the Meteorological Service by the scientific section of the Institut d' Estudis Catalans. The first number was dated November 1921 and the eighth has been received already. Such subjects as the nomenclature of winds, the movements of the air as shown by clouds, and the use of halos in forecasting have been dealt with. There are also quarterly reports on the rainfall of Catalonia, with monthly totals for about 80 stations.

As a general rule the last page of each pamphlet is utilised for official notices. From one of these we learn that monthly reunions of friends of the Meteorological Service of Catalonia have been arranged. At the first of these the subjects discussed were the meteorological conditions which produced the invasion of mildew in Catalonia in 1921 and the structure of cyclones according to the theories of Bjerknes.

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* Bjerknes and Solberg consider that the trail is made by snow falling from the tuft, but there does not seem to be any reason to suppose that the small crystals of which it probably consists would fall with appreciable speed. I have found that mare's tails can be imitated successfully by dropping ink into a pond when the upper layers are being moved by the wind and the lower layers, being stable after a cold night, are more sluggish.

News in Brief.

THE Climatological Station at Ranelagh, Dublin, has been closed since the middle of July. Mr. H. Fayle, who maintained it, having left Ireland.

OWING to the breakdown of communications in Ireland, there have been many gaps in the *Weekly Weather Report* and district values have not been published. One observer writes as follows : "I send reports every week, but no mails have been received here for more than two weeks, until yesterday, when a heavy mail arrived by river. Railways and roads are torn up, bridges are destroyed, and even river navigation is at times prohibited."

The semi-final of the Air Ministry Interdepartmental Cricket Competition between the Meteorological Office and the Directorate of Supply and Research was played at Eltham on Friday, 14th July. After a keen struggle the Office lost by 5 runs, the scores being 45 and 40.

The Society of Friends has presented to the library of the Meteorological Office a diary kept by a Mr. John Sanderson at Oustwick in the East Riding of Yorkshire, beginning in the year 1739. The diary contains a short description of the weather each month up to June 1772. There are a few omissions, as the following extract from the year 1764 shews :—

> "It may be note hear that I had much omited my monthly observaion of weather but the after part of this summer became prete favarable so that tho the fore part of tharvist was got bad ye the latter part was a time for geting it very good etc."

For ready reference it is highly desirable to have this diary transcribed and summarised. Is there any reader of the *Meteorological Magazine* who would care to undertake the work?

"FORMS whereon to write the numerical calculations described in *Weather Prediction by Numerical Process*, by L. F. Richardson,' have been published by the Cambridge University Press. These are on sale at 2s. the set.

In an interesting article which appears on the back of the *Monthly Meteorological Chart of the East Indian Seas* for September 1922, entitled "Surface Ocean Currents" by C. S. Durst, the author has used a large number of observations obtained from the logs of ships travelling on various routes to investigate Ekman's theory of the relation between surface current and wind.

DR J R SUTTON of Kimberley, South Africa, writes regarding a reported shower of frogs at Gibraltar (*Met Mag.* 1921, page 140) that the frogs were probably under the sand of the North Front and came out after rain. These "showers" often happen in South Africa, but the frogs do not come from the sky—they would be smashed to pulp if they did. It is interesting to watch them burying themselves. They go down backwards in soft ground.

A KITE balloon is now flown daily at the Meteorological Station, Great Wakering, two miles north-north-east of Shoeburyness, for the purpose of making meteorological observations. The balloon is normally flown at a height of approximately 10,000 feet. In order that the balloon and mooring cable should not constitute a danger to aircraft flying in the neighbourhood, the cable is marked with red and white streamers.

ELEMENTARY Meteorology is now included among the subjects of examination for persons applying for licenses as class B pilots, that is, as pilots of flying machines carrying passengers or goods.

A very severe typhoon accompanied by a tidal wave wrecked the town of Swatow, at the southern entrance of the Strait of Formosa, on the night of August 2nd. The typhoon is stated to be the worst ever experienced on the China coast and it is estimated that 10,000 Chinese were killed.

The Weather of July, 1922.

THE weather of July was generally unsettled, except in the extreme north. Rainfall throughout the British Isles was considerably above the average and temperature considerably below. The two depressions which crossed England in a north-easterly direction on the 5th and the 9th were remarkable for the gales in the Channel associated with them.

Reference to *The Weather of the British Coasts* shows how rarely gales have been recorded in the Channel in July.

On the first day of the month the main features of the pressure distribution were a depression between Iceland and Norway, a weak anticyclonic belt stretching from Spain over France to North Germany and another depression beginning to influence the west of the British Isles and causing local gales with rain. The slow advance of the Atlantic depression in a north-easterly direction on the 2nd and 3rd brought the whole of north-west Europe under cyclonic conditions with strong winds and general rain. A new depression which was indicated off the south-west of Ireland on the 4th moved across England on the 5th and 6th causing general rain, which in many places exceeded one inch and locally approached 3 inches. Gales were reported from the Channel during the passage of this depression. By the morning of the 9th the centre was off the coast of Norway and a fairer day was experienced in the British Isles and France, though heavy rain fell locally in showers. On the evening of the 7th a fresh depression was shown off the south-west of Ireland which crossed England in much the same track as its predecessor, causing strong gales in the Channel and heavy rain generally. A paragraph from '*The Yachting World*' states, " During this gale the L. & S.W. Rly. Co's steamer *Vera* took 18 hours to make the journey from Southampton to Jersey. Her captain says the gale was the worst in his experience extending over sixteen years; many of the seas were 30 feet in height or 60 feet from summit to trough." On Sunday the 9th the depression moved into the North Sea with improving weather in the British Isles and much rain in Norway. On Sunday evening another depression threatening the south-west of Ireland seemed likely to repeat the bad weather of the past week but filled up without crossing the British Isles, and a general rise of pressure throughout Monday resulted in the establishment of an anticyclone over the British Isles and North Germany on Tuesday 11th, giving fair weather generally except in Central Europe, where heavy rain was associated with a depression over Austria. On Wednesday the 12th the anticyclone began to give way before a depression over Iceland, and rain fell in the British Isles and Northern France on the Thursday. On Friday the 14th the depression remained stationary off the Hebrides, slowly filling up, but a secondary developing over the British Isles was accompanied by heavy rain and thunderstorms in south-east England and northern France. On Saturday 15th, St. Swithin's Day, the secondary moved into the North Sea, growing deeper, while pressure rose rapidly behind it with improving weather; small amounts of rain fell however in most places causing anxiety to the superstitious. It then moved slowly across to the Baltic with north-westerly winds and showery weather behind it during the following days. During this comparatively fair period the temperature rose considerably in France and Central Europe and sea fogs occurred in the Channel resulting in a collision between the *Remuera* and the *Marengo* on the morning of the 21st. Meanwhile by the evening of the 19th, backing winds and a falling barometer denoted the approach of another depression, which moved in a north-easterly direction giving rain in western districts. The next depression, on the 21st, remained stationary off the west of Ireland but developed a small secondary centred over London on Sunday morning giving general rain over England which locally in the midlands was very heavy.

During the 24th and 25th pressure rose over the British Isles forming an anticyclonic ridge with generally fair pleasant weather. On the 26th, western and northern districts were again feeling the effects of a deep depression off the Hebrides which moved slowly north without affecting the southern districts. During the 27th and 28th warm air coming round the Azores anticyclone over the comparatively cold waters of the Atlantic caused extensive patches of fog on the route of the Atlantic liners. The last few days of the month were of an unsettled westerly type with depressions passing between Iceland and Scotland. R. A. W.

During a violent thunderstorm over the Dijon district on the 5th the ninth-century church of Premières was struck by lightning and burnt. Torrential rain, accompanied by high wind, was experienced in Paris on the same night.

On the 17th snow was falling on the Swiss Alps at a height of only 5,000 feet above sea level. Heavy rainfalls in the lower lying regions caused floods in many parts of Switzerland in the third week of the month. Four members of the managing committee of the Swiss Alpine Club were caught in a heavy snowstorm on the Wildelsig ridge on the 23rd and two of them died from exposure.

Very heavy rain fell in Brandenburg and western Germany about the middle of the month. Severe cold was experienced in the Bavarian mountains in the third week of the month and 5 of a party of tourists climbing the Zugspitze were frozen to death.

The Indian monsoon has been slightly stronger than usual and gives good promise for agricultural operations. Excellent rains have fallen over the greater part of the country and there are only a few regions, notably Kathiawar, Cutch and parts of the Punjab where further rainfall is necessary. In some areas of the Deccan there has been about 1,000 mm. of rain and the sun has scarcely been seen for weeks. Two cyclones have occurred in the Bay of Bengal.

At the beginning of the month the temperature at Melbourne fell as low as 32° F. and snow occurred as far to the north-east as Albury on the River Murray. A message from Melbourne dated July 31st stated that the highest flood waters experienced in twenty years were slowly moving down the Murrumbidgee River and had gradually inundated the town of Wagga Wagga. The great Burrinjuck dam, the sixth largest in the world, at the headworks of the Murrumbidgee irrigation scheme, has so far stood the test well, although it is not yet completed.

A telegram from Seattle, Alaska, dated July 6th. stated that Captain Amundsen's ship the *Maud* had been kept back by adverse ice conditions in the Bering Sea. On the 15th the vessel was fixed in the ice in the neighbourhood of Good Hope Bay, Kotzbue Sound. Amundsen's arrival at Point Barrow and his projected aeroplane flight thence across the Polar basin have therefore been delayed.

The United States has had an unusually and persistently wet summer. The English practice of insuring against rain has been widely taken up and the insurance companies have consequently suffered very considerable losses this year.

(*Continued on p.* 202.)

Rainfall Table for July 1922.

STATION.	COUNTY.	Aver. 1881—1915.	1922.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	2·38	3·85	98	162	1·10	5	22
Tenterden (View Tower)	*Kent*	2·09	2·38	61	114	·78	5	16
Arundel (Patching Farm)	*Sussex*	2·40	3·83	97	160	1·22	5	17
Fordingbridge (Oaklands)	*Hampshire*	2·00	4·69	119	235	2·02	5	21
Oxford (Magdalen College)	*Oxfordshire*	2·27	3·56	90	157	1·14	5	16
Wellingborough (Swanspool)	*Northampton*	2·29	3·89	99	170	1·50	5	22
Hawkedon Rectory	*Suffolk*	2·44	3·75	95	154	·70	16	20
Norwich (Eaton)	*Norfolk*	2·59	7·33	186	283	2·70	14	20
Launceston (Polapit Tamar)	*Devon*	2·69	3·14	80	117	·80	5	18
Sidmouth (Sidmount)	„	2·51	3·54	90	141	1·24	5	15
Ross (Birchlea)	*Herefordshire*	2·25	4·46	113	198	1·55	5	17
Church Stretton (Wolstaston)	*Shropshire*	2·45	4·67	119	191	1·20	5	18
Boston (Black Sluice)	*Lincoln*	2·20	4·49	114	204	1·27	5	22
Worksop (Hodsock Priory)	*Nottingham*	2·27	3·35	85	148	1·25	5	17
Mickleover (Clyde House)	*Derbyshire*	2·45	4·02	102	164	1·58	5	19
Southport (Hesketh Park)	*Lancashire*	2·86	4·81	122	168	1·69	5	19
Wetherby (Ribston Hall)	*York, W. R.*	2·50	5·84	148	234	1·86	5	14
Hull (Pearson Park)	„ *E. R.*	2·34	4·80	122	205	1·51	5	21
Newcastle (Town Moor)	*North'land*	2·65	5·08	129	192	1·37	5	17
Borrowdale (Seathwaite)	*Cumberland*	8·46	10·00	254	118	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	3·11	5·19	132	167	1·07	5	20
Haverfordwest (Gram. Sch.)	*Pembroke*	3·20	6·29	160	197	·98	17	16
Aberystwyth (Gogerddan)	*Cardigan*	3·86	4·79	122	124	·96	5	10
Llandudno	*Carnarvon*	2·39	2·69	68	113	1·33	5	19
Dumfries (Cargen)	*Kirkcudbrt.*	3·24	4·74	120	146	·78	20	21
Marchmont House	*Berwick*	3·05	5·40	137	177	·83	6	19
Girvan (Pinmore)	*Ayr*	3·65	3·44	87	94	·93	26	24
Glasgow (Queen's Park)	*Renfrew*	2·92	2·29	58	78	·54	8	21
Islay (Eallabus)	*Argyll*	3·41	3·95	100	116	·59	28	24
Mull (Quinish)	„	4·05	4·51	115	111	·84	20	23
Loch Dhu	*Perth*	4·83	5·60	142	116	1·00	1	19
Dundee (Eastern Necropolis)	*Forfar*	2·74	3·25	83	119	·54	8	19
Braemar (Bank)	*Aberdeen*	2·57	3·46	88	135	·53	9	19
Aberdeen (Cranford)	„	2·96	4·40	112	149	1·18	8	19
Gordon Castle	*Moray*	3·20	3·77	96	118	1·44	9	20
Fort William (Atholl Bank)	*Inverness*	4·83	5·18	132	107	·75	30	25
Alness (Ardross Castle)	*Ross*	3·03	3·30	84	109	·52	1	21
Loch Torridon (Bendamph)	„	5·42	4·37	111	81	·90	20	18
Stornoway	„	3·03	2·52	64	83	·32	30	22
Loch More (Achfary)	*Sutherland*	5·35	3·77	96	70	·91	1	24
Wick	*Caithness*	2·63	3·16	80	120	·87	9	22
Glanmire (Lota Lodge)	*Cork*	2·90	3·74	95	129	1·05	7	21
Killarney (District Asylum)	*Kerry*	3·32	..	..	..	..	..	..
Waterford (Brook Lodge)	*Waterford*	3·24	2·94	75	91	·61	7	19
Nenagh (Castle Lough)	*Tipperary*	3·14	3·46	88	110	·75	7	24
Foynes	*Limerick*	3·08	3·56	91	116	..	..	..
Gorey (Courtown House)	*Wexford*	2·94	3·21	81	109	·74	8	15
Abbey Leix (Blandsfort)	*Queen's Co.*	3·13	3·13	79	100	·44	7	20
Dublin (FitzWilliam Square)	*Dublin*	2·56	2·30	58	90	·42	8	22
Mullingar (Belvedere)	*Westmeath*	3·18	3·28	83	103	·54	17	24
Crossmolina (Enniscoe)	*Mayo*	3·64	..	..	..	..	..	..
Collooney (Markree Obsy.)	*Sligo*	3·46	4·48	114	129	·91	7	20
Seaforde	*Down*	3·19	3·65	93	114	·52	28	24
Ballymena (Harryville)	*Antrim*	3·43	3·86	98	113	·47	28	24
Omagh (Edenfel)	*Tyrone*	3·40	4·63	118	136	·72	28	20
Letterkenny Asylum	*Donegal*	3·50	3·96	101	113	·72	8	25

Supplementary Rainfall, July 1922.

Div.	STATION.	RAIN.	
		in.	mm.
II.	Ramsgate	1·88	48
,,	Sevenoaks, Speldhurst	3·64	93
,,	Hailsham Vicarage...	2·82	72
,,	Totland Bay, Aston Ho.	3·43	87
,,	Ashley, Old Manor Ho.	3·57	91
,,	Grayshott...........	4·84	123
,,	Ufton Nervet........	4·68	119
III.	Harrow Weald, Hill Ho.	3·43	87
,,	Pitsford, Sedgebrook..	3·62	92
,,	Chatteris, The Priory.	3·10	79
IV.	Elsenham, Gaunts End	3·29	84
,,	Lexden, Hill House ..	2·71	69
,,	Aylsham, Rippon Hall	5·12	130
,,	Swaffham...........	4·37	111
V.	Devizes, Highclere ...	3·51	89
,,	Weymouth..........	4·08	104
,,	Ashburton, Druid Ho.	5·86	149
,,	Cullompton	3·26	83
,,	Hartland Abbey	3·06	78
,,	Penzance, Morrab Gden.	4·23	107
,,	St. Austell, Trevarna.	4·70	119
,,	Crewkerne Merefield Ho	4·71	120
VI.	Clifton College	3·63	92
,,	Ledbury, Underdown.	4·12	105
,,	Shifnal, Hatton Grange	4·35	111
,,	Ashbourne, Mayfield.	4·94	126
,,	Barnt Green, Upwood	4·44	113
,,	Blockley, Upton Wold	4·39	111
VII.	Leicester, Town Hall Sq.	4·26	108
,,	Grantham, Saltersford	4·96	126
,,	Louth, Westgate	5·06	129
,,	Mansfield, West Bank	4·41	112
VIII.	Nantwich, Dorfold Hall	3·76	95
,,	Bolton, Queen's Park.	4·95	126
,,	Lancaster, Strathspey.	5·39	137
IX.	Wath-upon-Dearne...	2·54	65
,,	Bradford, Lister Park.	4·24	107
,,	West Witton.........	4·16	106
,,	Scarborough, Scalby..	4·64	118
,,	Middlesbro', Albert Pk.	3·90	99
,,	Mickleton...........	2·70	69
X.	Bellingham	3·90	99
,,	Ilderton, Lilburn	4·68	119
,,	Orton...............	7·19	183
XI.	Llanfrechfa Grange ..	4·05	103
,,	Treherbert, Tyn-y-waun	11·92	303
,,	Carmarthen Friary ..	6·37	162
,,	Lampeter, Falcondale	6·51	165
,,	Cray Station	7·20	183
,,	B'ham W.W., Tyrmyndd	7·34	186
,,	Lake Vyrnwy.......	6·78	172
,,	Llangynhafal, P. Drâw	3·46	88
,,	Oakley Quarries	6·00	152
,,	Dolgelly, Bryntirion..	5·50	140
,,	Snowdon, L. Llydaw.	..	..
,,	Lligwy	3·15	80
II.	Stoneykirk, Ardwell Ho.	3·71	94
,,	Carsphairn, Shiel.....	4·50	114
XII.	Langholm, Drove Rd.	7·59	193
XIII.	Ettrick Manse	5·58	142
,,	North Berwick Res....	2·74	70
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Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L. mb.	Diff. from Normal mb.	Max. ° F.	Date	Min. ° F.	Date	Max. ° F.	Min. ° F.	½ max. and min. ° F.	Diff. from Normal ° F.
London, Kew Observatory	1012·9	−2·8	58	25	27	7	47·3	36·0	41·7	+1·6
Gibraltar	1019·8	+1·0	69	3, 27	46	7, 18. 28	62·3	50·2	56·3	−0·3
Malta	1015·2	+0·2	64	5, 6, 7	46	9	59·4	52·8	56·1	+1·4
Sierra Leone	1010·9	−0·1	94	16	73	17, 22, 27	90·6	74·6	82·6	+0·3
Lagos, Nigeria	..	..	..	..	..	..	..	..	..	..
Kaduna, Nigeria	..	..	..	..	..	..	..	..	..	..
Zomba, Nyasaland	1007·4	−0·4	91	19	62	7, 17 28	81·3	64·7	73·0	+1·3
Salisbury, Rhodesia	1006·1	−3·8	92	19	50	21, 22	81·8	56·5	69·1	+0·2
Cape Town	1013·8	+0·4	97	5	56	9	79·8	60·9	70·3	+0·3
Johannesburg	1011·5	+0·3	83	17, 23	49	• 28	76·0	55·4	65·7	+0·3
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	..	..	91	14	43	20	86·4	57·9	72·1	+0·2
Calcutta, Alipore Obsy.	1012·3	−1·0	96	26	51	2	87·0	59·9	73·5	+2·5
Bombay	1011·5	−1·1	89	6	62	4	84·9	70·2	77·5	+1·9
Madras	1014·3	+1·5	94	26	61	27	86·8	67·8	77·3	−0·4
Colombo, Ceylon	1010·7	+0·1	90	15	68	28	87·7	72·0	79·9	−0·7
Hong Kong	1015·5	−3·3	73	7	49	27	65·0	58·1	61·5	+2·4
Sandakan	..	..	89	4, 22. 27	72	3	86·1	74·7	80·4	+0·3
Sydney	1013·1	−0·9	83	9	61	6, 28	78·4	65·6	72·0	+0·8
Melbourne	1012·6	−1·9	105	16	48	15	80·5	59·3	69·9	+2·5
Adelaide	1012·0	−2·3	106	11	51	28	88·1	62·8	75·5	+1·4
Perth, Western Australia	1010·8	−2·3	105	22	50	16	84·2	62·3	73·3	−0·7
Coolgardie	1009·9	−2·6	112	9	50	16	91·8	62·1	76·9	+0·9
Brisbane	1009·6	−2·6	89	27	65	6	81·4	68·9	75·1	−1·4
Hobart, Tasmania	1014·3	+0·8	97	12	47	15	70·9	54·7	62·8	+0·4
Wellington, N.Z.	1016·9	+1·6	82	28	41	7	71·9	56·0	63·9	+1·5
Suva, Fiji	1008·5	+0·8	90	1, 8	69	19	87·7	72·3	80·0	−0·5
Kingston, Jamaica	1015·5	−0·2	89	27	66	10	85·8	67·8	76·8	+0·3
Grenada, W.I.	1014·4	+1·0	85	1, 9	70	6, 22, 25	82·0	71·9	76·9	−0·1
Toronto	1019·2	+1·2	48	23	− 7	17	33·9	19·1	26·5	+4·8
Winnipeg	1022·3	+0·5	23	25	−25	11	10·1	−9·3	0·4	+1·0
St. John, N.B.	1017·0	+2·9	45	20	−14	18	28·9	11·7	20·3	+0·4
Victoria, B.C.	1015·8	−0·1	52	16	25	1	43·4	32·5	37·9	−2·4

London, Kew Observatory.—Prevailing wind direction SW, mean speed 9·9 mi/hr. 1 day with thunder heard, 2 days with snow.

Gibraltar.—Prevailing wind direction NW or E. 2 days with gale.

Malta.—Prevailing wind direction WNW.

Sierra Leone.—Prevailing wind direction SW.

Salisbury, Rhodesia.—Prevailing wind direction easterly.

Colombo, Ceylon.—Prevailing wind direction NNW., mean speed 5·0 mi/hr. 2 days with thunder heard.

British Empire, February 1922.

TEMPERATURE		Relative Humidity	Mean Cloud Am'nt	PRECIPITATION				BRIGHT SUNSHINE		STATIONS
Mean Wet Bulb.	Absolute Min. on Grass			Amount		Diff. from Normal	Days	Hours per day	Percentage of possible	
° F.	° F.	%	0–10	in.	mm.	mm.				
39·7	17	78	6·1	1·87	48	+ 9	14	3·2	33	London, Kew Observatory.
52·4	36	80	3·2	3·06	78	– 29	7	..	..	Gibraltar.
51·7	42	81	5·8	0·94	24	– 27	9	5·1	47	Malta.
74·5	..	63	1·1	0·00	0	– 7	0	..	..	Sierra Leone.
..	..	..	..	..	..	..	..	..	..	Lagos, Nigeria.
..	..	..	..	..	..	..	..	..	..	Kaduna, Nigeria.
..	..	83	6·7	4·64	118	–158	10	..	..	Zomba, Nyasaland.
63·3	..	64	3·6	4·74	120	– 62	12	..	..	Salisbury, Rhodesia.
63·4	..	59	2·6	0·87	22	+ 7	4	..	..	Cape Town.
56·7	50	70	5·3	3·06	78	– 52	12	7·9	61	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
59·8	..	57	2·1	1·09	28	– 60	7	..	..	Bloemfontein.
63·5	42	35	0·5	0·00	0	– 29	0*	..	..	Calcutta, Alipore Obsy.
68·9	51	63	0·5	0·00	0	– 1	0*	..	..	Bombay.
69·8	56	66	2·5	0·00	0	– 8	0*	..	..	Madras.
75·4	60	67	5·0	2·12	54	+ 1	6	..	..	Colombo, Ceylon.
58·5	..	83	8·7	5·49	139	+ 96	12	2·8	25	Hong Kong.
76·9	..	86	..	25·60	650	+406	14	..	..	Sandakan.
67·5	56	70	5·5	2·55	65	– 51	14	6·6	49	Sydney.
62·5	42	57	5·0	3·63	92	+ 48	11	..	..	Melbourne.
61·2	40	39	2·6	0·05	1	– 16	2	10·1	76	Adelaide.
64·1	44	51	3·4	0·21	5	– 7	4	9·3	71	Perth, Western Australia.
63·8	..	35	3·5	0·92	23	+ 4	3	..	..	Coolgardie.
71·0	62	75	7·1	7·55	192	+ 27	21	..	..	Brisbane.
57·1	41	68	6·6	2·55	65	+ 28	13	6·1	44	Hobart, Tasmania.
58·8	28	72	6·4	1·07	27	– 56	8	7·2	52	Wellington, N.Z.
77·7	..	86	4·9	16·12	409	+152	18	..	..	Suva, Fiji.
..	..	73	4·1	0·45	11	– 4	5	..	..	Kingston, Jamaica.
72·1	..	75	4·9	5·07	129	+ 57	24	..	..	Grenada, W.I.
22·5	–11	57	6·7	2·95	75	+ 9	17	..	..	Toronto.
2·1	..	..	4·5	0·74	19	– 1	10	..	..	Winnipeg.
17·8	–14	63	6·0	2·92	74	– 25	14	..	..	St. John, N.B.
34·8	19	83	6·1	1·99	51	– 39	16	..	..	Victoria, B.C.

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

HONG KONG.—Prevailing wind direction E., mean speed 15·4 mi/hr. 1 day with thunder heard, 3 days with fog.

PERTH.—Prevailing wind direction SE, mean speed 15·2 mi/hr.

HOBART.—1 day with thunder heard.

WELLINGTON, N.Z.—Prevailing wind direction variable.

SUVA, FIJI.—Prevailing wind direction north-easterly. 10 days with thunder heard.

GRENADA, W.I.—Prevailing wind direction E.

(*Continued from p.* 197.)

A stationary depression over the province of Entre Rios in the Argentine at the end of June and beginning of July gave very heavy rains accompanied by gales. As the storm followed a period of six weeks of almost continuous rain the country round Buenos Aires was very extensively flooded. The storm played much havoc in the capital, many parts of which were under water. A few buildings collapsed and there was a general disorganization of transport and industry. The week ending July 12th was cloudy and abnormally warm over the country in general, the temperature on several days being 5° to 10° higher than the normal for the season.

The special message from Brazil states that the rainfalls of the northern and central regions were respectively 48 mm. and 124 mm. above the normal while that of the southern region was 32 mm. below the normal. Temperature was a little above normal over the whole country but a cold period with slight frosts occurred at the beginning of the month. The cane and cotton crops were still feeling the consequences of last month's heavy rain, and wheat was slightly affected by the relatively high temperature. Pressure at Rio de Janeiro was 4 mm. above the normal.

The rainfall of July was of particular interest in England and Wales where it was unusually heavy. More than the average occurred everywhere and generally the excess reached as much as 50 per cent. The principal areas with small excesses lay along the west coast and in the south-east corner of England. As much as twice the average occurred over considerable areas in Hampshire, Lincolnshire and Norfolk, where 283 per cent. of the average was reached at Norwich.

In England and Wales the rainfall was everywhere greater than 50 mm. (2 in.). Considerable areas, including parts of the Thames Valley, received more than 125 mm. (5 ins.) and as much as 150 mm. (6 in.) in places. In the high land of Glamorgan and the Lake District more than 250 mm. (10 in.) fell.

Although so large an excess in England and Wales is unusual it is only necessary to go back to 1920 to find a July with greater general rainfall than that of 1922.

The large falls for the month can in part be attributed to the widespread heavy rain of the 5th, when over the whole of England and Wales, with the exception of coastal strips in the west and south-east, more than 25 mm. (1 in.) fell. As much as 100 mm. (2 in.) was recorded over a considerable area in the south of England chiefly from about Reading and Haslemere in the north-east to Crewkerne and Wareham in the south-west. At Selborne in Hampshire as much as 72 mm. (2·85 in.) was recorded on that day.

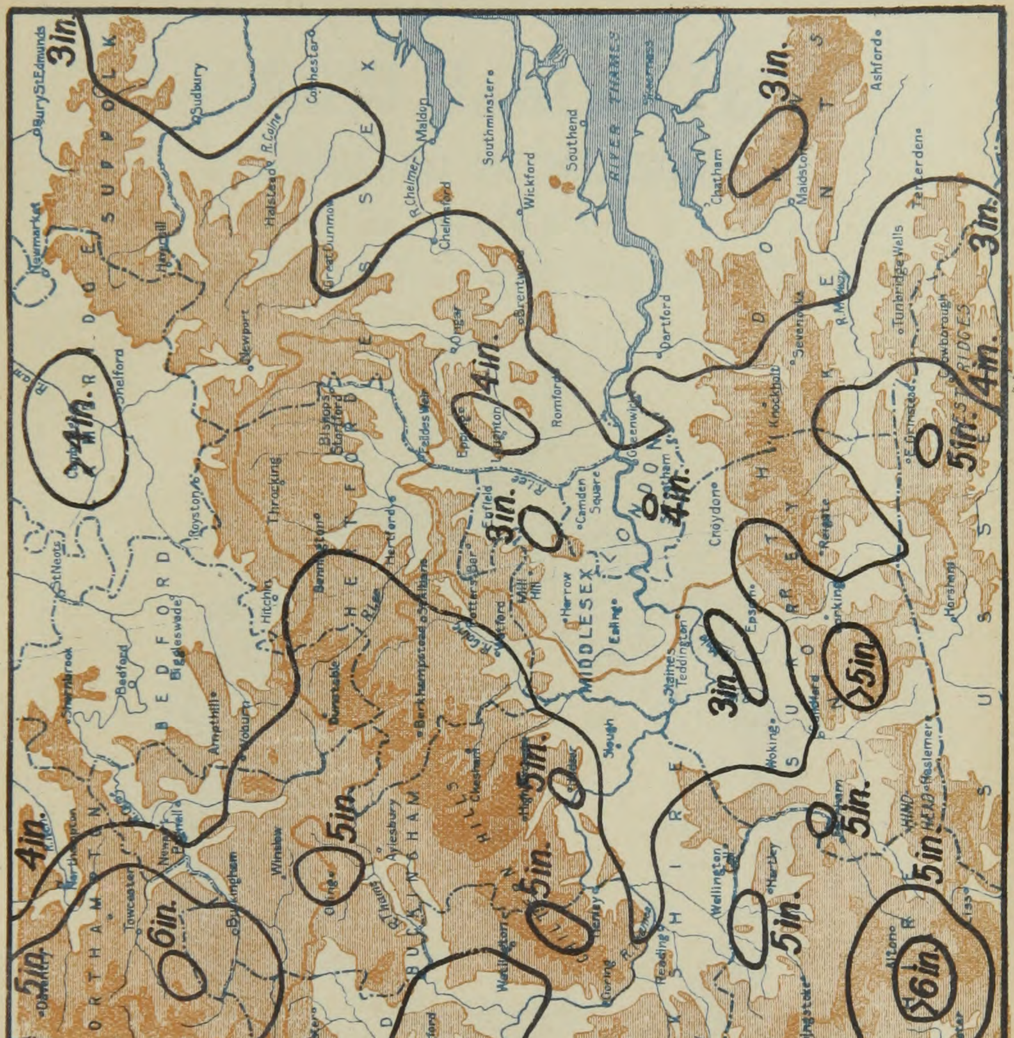
Heavy falls occurred on other days during the month. On the 23rd as much as 67 mm. (2·65 in.) was recorded at Keresley Grange, Coventry, and on the 14th 72 mm. (2·82 in.) at Frankfort Manor to the north of Norwich.

In Scotland and Ireland the rainfall was much more normal. Slightly less than the average occurred in the south-west of Ireland and in the north-west and south-west of Scotland. Excesses of more than 25 per cent. occurred in Co. Tyrone and Aberdeenshire.

The general rainfall expressed as a percentage of the average was: England and Wales 172: Scotland 113: Ireland 112: British Isles 139.

In London, Camden Square, the mean temperature was 59·5° F., or 3·9° F. below the average, the duration of rainfall 59·2 hours, and the evaporation 2·09 inch.

THAMES VALLEY RAINFALL —— JULY, 1922.



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*Watershed of River Thames above Teddington, and River Lea above Feildes Weir.

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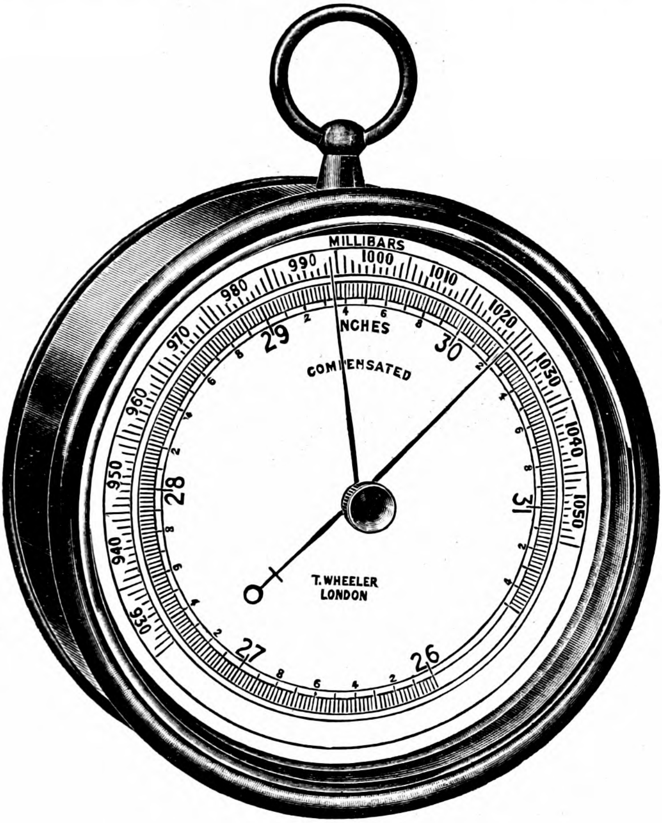
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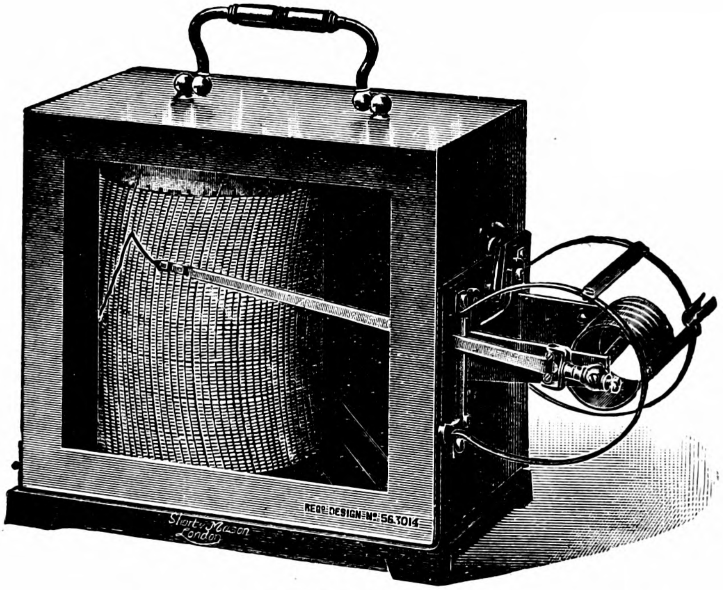

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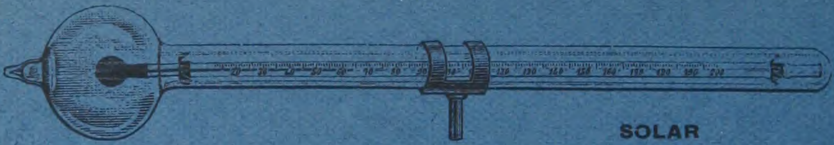

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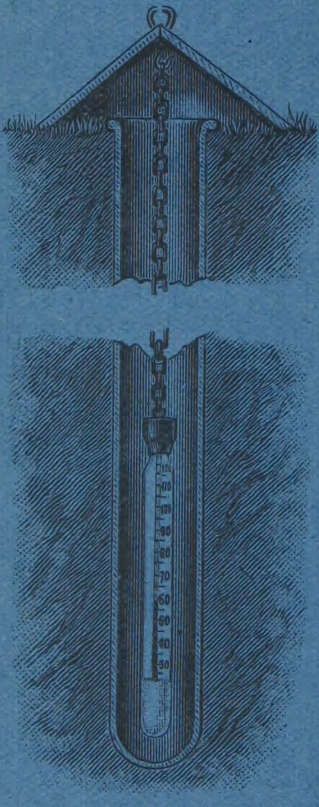

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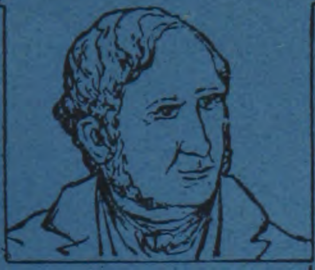
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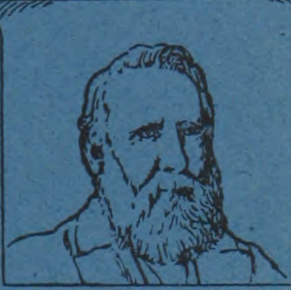
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SEPTEMBER, 1922.

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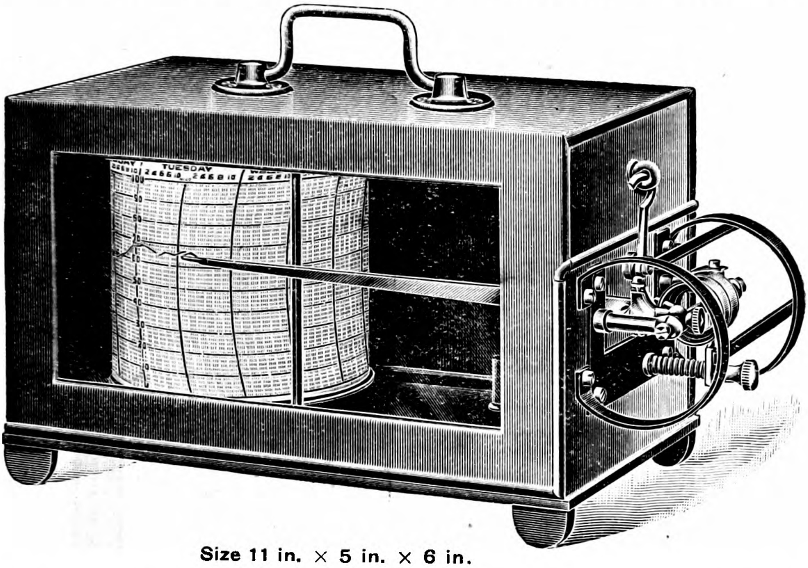

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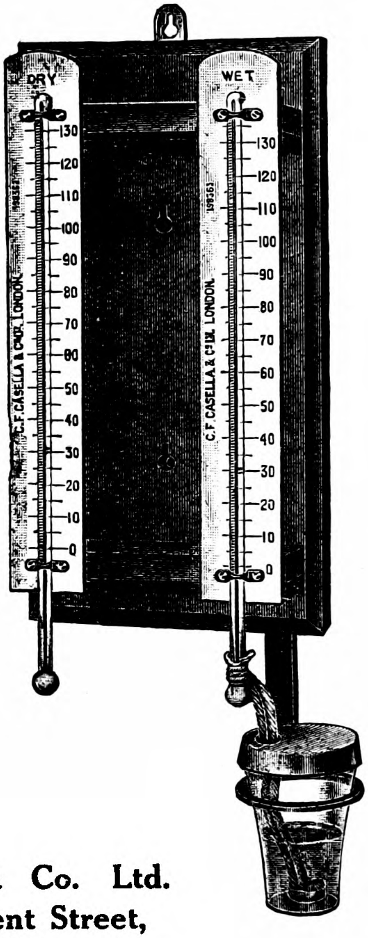
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The Meteorological Magazine

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No. 680

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EDINBURGH; or from THE METEOROLOGICAL OFFICE, SOUTH KENSINGTON, LONDON, S.W. 7.

A Period of Warm Winters in Europe.

By C. E. P. Brooks, M.Sc.

AMONG the most interesting problems of meteorology are the local changes of climate extending over years or even decades. Their causes are usually obscure and often the most that can be said is that they are secondary effects of long-period fluctuations in the circulation of the earth's atmosphere. An example which has recently come to light is the abnormal winter warmth of Central Europe during the decade 1911 to 1920.

The differences between the mean temperatures for January, February and December of the years 1911 to 1920, and the long-period averages for the several stations (usually covering the years 1851–1910), are shown in the chart on p. 204, from which it appears that the maximum effect, exceeding 3° F., extends in a long belt from Denmark (Copenhagen + 3·3° F.) to the Balkan Peninsula (Sofia + 3·2° F.). At Budapest, near the centre of this area, the difference exceeds 4° F.; that is to say, the winters of the past ten years at this town have on the average been more than four degrees warmer than the normal winter. From the central isanomaly of 3° F. the excess falls off rapidly in all directions except the west, where it is 2·6° F. at Zürich, 2·1° F. at Paris and 1·8° F. at Kew. On the Atlantic sea-board the winters of the decade in question have been slightly colder than the normal.

Over most of the area the effect reaches its maximum in December and is also well developed in the early spring. For the rest of the year there is no appreciable difference; in fact, during the summer months, the years 1911 to 1920 have been on

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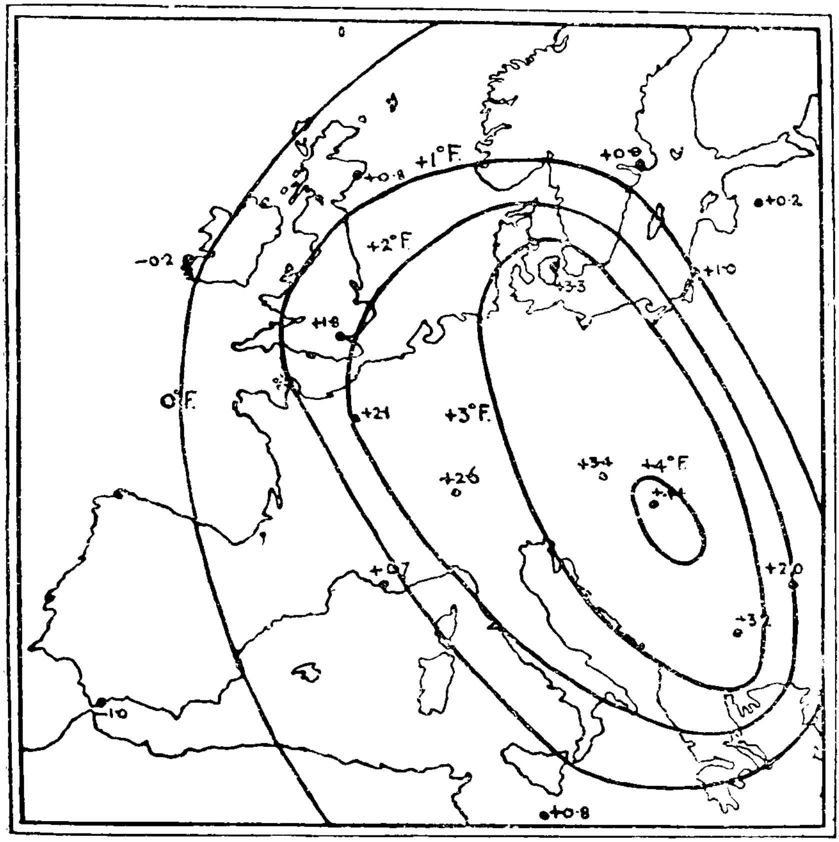

Differences between the Mean Temperature, Winter Months 1911–1920, and the corresponding Long-period Means.

the average somewhat cooler than the normal in Central Europe, though the difference nowhere reaches 2° F. The mean annual temperatures have been as much as 1·5° F. above the normal.

Failing registering balloon ascents, the data of St. Gothard (6,877 feet) have been examined to discover if the phenomenon is confined to low levels. At this station the mean winter temperature (1911 to 1920) is 1·9° F. above the long-period normal, while at Zürich (1,542 feet), a short distance further north, the difference is 2·6° F. The abnormal warmth was therefore not confined to low levels and is probably not a radiation effect.

We have here an appreciable change of climate which appears to be analogous to the Brückner cycle, but not identical with it, because the Brückner cycle should give low instead of high temperatures during the past decade. A tentative explanation connects it with the general decrease of sunspot numbers since the nineteenth century. Sunspot numbers are an index of the intensity of the solar radiation, which governs the strength of the earth's atmospheric circulation. Now a by-product of this circulation is the gradient between the sub-tropical Atlantic anticyclone and the Icelandic minimum. The nearest point to the former for which recent data are available is Lisbon, and we find that during the period 1911 to 1918 the mean winter pressure at Lisbon was 0·5 mb. below the normal, while at Iceland it was 1·2 mb. above normal, decreasing the mean gradient between these two places from 21·2 mb. to 19·5 mb. At first sight this should mean decreased south-westerly winds from the Atlantic and consequently *lower* winter temperatures over Central Europe, but it happens that the winter weather in this region is mainly anticyclonic and is only slightly affected directly by the Atlantic pressure gradient. Its severity is, however, very much lessened when frequent depressions break through, and this happens most readily when the atmospheric circulation is weakest and the oceans are, accordingly, relatively cold.

When the air circulation is strong, that of the ocean is strong also, and in temperate latitudes the waters are highly warmed so that depressions follow the coasts and the continental anticyclones escape their influence.

This hypothesis in only tentative, but it agrees with Brückner's conclusions based on his studies of the 35-year cycle,[1] and also with those based on the study of the secular variation of the annual means of pressure and temperature since 1870.[2]

OFFICIAL NOTICE.

The Meteorological Committee.

The Board of Trade has appointed Capt. R. C. Warden, C.B.E., Principal District Officer of the Mercantile Marine Department for the London District, as their nominee on the Meteorological Committee to succeed Capt. D. Fulton, who died on March 20th, 1922.

Lectures on Meteorology.

THE following is the provisional programme of lectures and classes for the School of Meteorology of the Imperial College of Science and Technology in the session 1922–23.

1. General Course of twenty-one lectures by Captain D. Brunt on *Advanced Meteorology, Dynamical and Physical*, on Mondays at 3.30 p.m. during the winter and spring terms, beginning on Monday, October 9th, 1922.

---

[1] *Klimaschwankungen seit 1700.* Wien, 1890.

[2] Brooks, C.E.P. *The Secular Variation of Climate.* Geogr. Rev., New York, N.Y., 11, 1921, p. 120.

2. Technical courses:

(*a*) Seven lectures by Sir Napier Shaw, F.R.S., on *Meteorological Conditions of the Air-Routes of the World,* at 3 p.m. on Fridays, October 13th, 20th and 27th and November 3rd, 10th, 17th and 24th.

(*b*) Three lectures by Mr. R. A. Watson-Watt on *Wireless Telegraphy and Weather,* at 3 p.m., on Fridays, December 1st, 8th and 15th.

3. An open course of ten lectures on *Forecasting Weather* by Sir Napier Shaw, F.R.S., on Fridays at 3 p.m. during the spring term, beginning on Friday, January 19th, 1923.

4. Discussions on the *Incidents of the Weather Charts of the previous week,* on Saturdays at 10 a.m. during term-time throughout the year, beginning on Saturday, October 14th, 1922.

Further particulars of these courses may be obtained from The Secretary, Imperial College of Science and Technology, South Kensington, S.W.7.

Discussions at the Meteorological Office.

The series of meetings held at the Meteorological Office, South Kensington, for the informal discussion of important contributions to meteorological literature, especially in foreign and colonial journals, will be continued this year.

The meetings will be held on Mondays at 5 p.m. on the following dates:—October 16th and 30th; November 13th and 27th; December 11th, 1922; January 22nd; February 5th and 19th; March 5th and 19th, 1923.

At the first meeting, October 16th, Sir Napier Shaw, F.R.S., will open the discussion of a paper by V. Bjerknes "On the dynamics of the circular vortex with application to the atmosphere and atmospheric vortex and wave motions." *Geofysiske Publikationer,* Vol. II., No. 3.

The Editors wish to thank the many readers who have volunteered to transcribe the 18th century diary lately presented to the Meteorological Office Library, and to state that the work has now been taken in hand.

Meteorological observers are reminded that Summer-Time will cease on October 8th, at 2 h. G.M.T.

Correspondence.

To the Editors, *The Meteorological Magazine.*

The Underground Water Level in the neighbourhood of the North and South Downs.

Some account of the underground water level at Detling was published in *The Meteorological Magazine* for May, 1922. Further investigation now shows that the marked deficiency in the underground water supply of the North Downs is still continued.

The following table compares the water level in 1922 with the average for 1911–1921. Wells 1, 2 and 3 are deep-seated and are situated on the gentle dip slope of the northern escarpment of the North Downs, No. 4 is low on the southern escarpment and No. 5 slightly lower still. All are, therefore, in the belt of Middle Chalk. The depth varies from 270 feet to 62 feet and in each case the draught is extremely slight.

DATE.	(1) Hucking (Old Forge).		(2) Stockbury Village.		(3) Little Pett.		(4) Detling (The Croft).		(5) Detling (Naylor's).	
	1922.	Aver. 1911-1921.	1922.	Aver. 1911-1921.	1922.	Aver. 1911-1921.	1922.	Aver. 1911-1921.	1922.	Aver. 1911-1921.
	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet
May 1	38·3	65·9	33·11	42·7	21·1	58·1	0·0	22·7	1·3	15·4
June 1	31·2	67·7	30·7	42·1	21·1	59·1	0·0	20·1	0·9	13·1
July 1	29·2	66·2	27·1	43·2	19·1	58·6	0·0	18·9	0·2	11 9
Aug. 1	35·0	64·5	28·3	41·9	19·8	55·4	1·0	16·5	0·0	10·0

This abnormally low level is not indicated in the chalk district of west Sussex, the southern South Downs, a fact well shown by the figures for Chilgrove, given below :—

DATE.	CHILGROVE.		
	1922.	Average 1911–1921.	Average 1836–1919.
	feet	feet	feet
April 30 - -	61·0	65·8	55·0
May 31 - - -	50·7	54·3	46·0
June 30 - - -	39·5	39·1	38·0
July 31 - - -	30·5	30·8	30·0

At Compton, in the same neighbourhood, the level at the end of May 1922 was higher than in 19 of the previous 29 years. Comparative rainfall for the two areas as exemplified by Detling and Chilgrove is also significant :—

PERIOD.	North Downs (Middle Chalk). Detling.			South Downs (Upper Chalk). Chilgrove.		
	Average. 1885-1919	1920-1921.	1921-1922.	Average. 1836-1919	1920-1921.	1921-1922.
	in.	in.	in.	in.	in.	in.
Winter (Oct. 1 to March 31).	15·23	9·77	11·34	19·23	15·75	15·99
Summer (Apr. 1 to Sept. 30).	12·92	6·64	—	15·08	6·88	—
Jan. 1 to July 31	—	—	16·07	—	—	21·72

Three factors appear to contribute to the marked difference in the underground water level in the two areas.

Firstly, the extreme deficit in rainfall for the period October 1920 to October 1921, though noticeable in both districts, was less marked at Chilgrove. Secondly, the presence of more open strata and of flint courses in the Upper Chalk zone permits of much freer percolation than is possible in the relatively impermeable Middle Chalk zone. Lastly, pumping is carried out to a great extent in the region of the North Downs, owing largely to the presence of such towns as Rochester and Chatham, while in the South Downs such pumping is very limited. Experience has shown that under normal conditions pumping affects the water level for a short time only—some five or six hours—but it is probable that after a sequence of dry seasons it tends to lower the underground level in a marked degree.

SPENCER RUSSELL.

Fonthill Cottage, Dorking, August 1922.

Cigar-shaped Clouds: Observations near the South Downs.

ON the evening of Monday, June 12th, near Washington, Sussex, I observed a cloud formation of a striking character. The day had been warm; on the crest of the downs the sea-breeze sprang up about midday and persisted all the afternoon. A few minutes before 19h. G.M.T. I noticed a dull coloured patch of lower cloud, perhaps cumulus, contrasting with the white upper cloud, cirro-stratus. The upper cloud was apparently moving from the north and was soon clear of the lower. At that time the lower cloud developed very rapidly until it assumed the form of a great cigar or a zeppelin. This cigar-cloud lay nearly parallel to the crest of the downs and perhaps two miles away. There was nothing to suggest a whirling movement in the cloud until a later stage, when it looked more like a distaff. By that time the cloud had moved a considerable distance to the north and the omnibus which I had mounted was overtaking it. About the same time two more clouds of the same shape, though smaller and not so perfect, had formed between the first and the downs. A fourth which formed about 19h. 20m. proved the most persistent of all. Number one evaporated just before number four reached its best development. The stereoscopic effect was well marked throughout, as the axes of the zeppelins were pointing towards the sun.

It is difficult to place these clouds in any of the well-known classes. They did not suggest the crests of waves such as might be formed in the air streaming over the downs. The analogy of the eddies formed by an obstacle and drifting downstream with the current is inviting, but is is difficult to account for sufficient cooling to allow of condensation in the centre of each eddy since there was no direct evidence of violent movement. It is possible that the clouds marked the transition between the sea breeze below and the return current above.

I should like to have references to similar observations.

July, 1922. F. J. W. WHIPPLE.

I DO not know that I have ever seen anything quite like that which Mr. Whipple describes. I have seen zeppelin-shaped clouds, but at cirro-cumulus heights. These I have seen many times with north-westerly winds both in Hampshire and on Salisbury Plain. I have one or two not very good photographs. I have seen similar clouds in the south of France with the mistral blowing.

I have also seen whale-black clouds over the downs, but these were actually resting on the hills; they are obviously caused by a wind that is blowing over the downs, condensation taking place where the air is forced upwards, and evaporation taking place on the leeward side. These clouds are wonderfully smooth in their outlines: they follow the hill contours, making an appearance as though the hills had suddenly grown higher. The appearance is very well described by Richard Jefferies in *Wild Life in a Southern County*. I fancy these clouds are very common over the downs near Freshwater. In such clouds the whole upper part of the cloud is perfectly smooth, like the surface of a stream when it just begins to go over a waterfall. C. J. P. CAVE.

Stoner Hill, Petersfield, July 15th, 1922.

Meteorology and Folklore.

Clouds.

RUSKIN has called the attention of an indifferent modern world to the beauties of the sky, to the changing panorama of cloudland, ranging from the delicate tracery of cirrus to the solid majesty of cumulus.

Nor was primitive man indifferent to the fascination of the sky-scape. The ancient Indians saw in the white summer clouds the Apsaras (" those who go in the water "), beautiful swan-maidens bathing in the heavenly lake. The Norsemen, seeing the ragged clouds driven before a sou'wester or hanging round a desolate mountain top, thought of the Valkyries (also on occasion " swan-maidens ") riding through the air on their white steeds, from whose manes dropped the frost and dew. It is remarkable how the spirit of this ancient meteorological myth has been embodied by Wagner in Act III. of *Die Walküre*, " a drama," as one critic half-jestingly said, " in which clouds play the leading role." Somewhat similar is the Tartar myth of the swan-women, of whom there are forty, but who can run together into one, so that at one time there is but one and at another the sky is dark with their wings.

Sometimes clouds assume a boatlike form. Such a formation has received various names, " Noah's Ark," a " sea-ship," a " cloud-ship " or " Mary's ship," and is regarded as a weather prognostic. But at one time it had a crew : it was the " Ship of Souls." A wild tale, current in Cornwall, tells how, as a pirate (in some versions a witch) was dying, a phantom ship came up in a cloudy squall and carried off his soul. Agobard, Bishop of Lyons in the ninth century, has left on record that many in his day believed in a country called Magonia, whence sailed ships among the clouds, whose crews poured down hail and tempests.

The Greeks believed the white clouds to be Apollo's white cattle shepherded by the wind Mercury. As they probably meant cirro-cumulus or cumulus it is easy to see how this myth was suggested by the woolly aspect of the clouds in question, the former being popularly known in France as " Moutons " and in Germany as " Schäfchenwolken." In Buckinghamshire they are called " packet-boys," and are said to be packets of rain soon to be opened. In conclusion it may be interesting to mention the convenient way in which the people of Southern Germany formerly accounted for weather changes—they were all Frau Holle's domestic activities. White clouds were her linen, grey her spinning threads, when it snowed she was shaking her bed, and last but not least rain was the result of her having a washing day! CICELY M. BOTLEY.

10, Wellington Road, Hastings, August 1st, 1922.

Cloud Nomenclature.

Is not Dr. R. Sutton under a misapprehension in thinking "some observers would call the 'cirro-stratus' *alto-stratus*"? I was under the impression that they were distinctly different forms of cloud, the former being some eight kilometres above the earth's surface (about five miles), whilst the latter's altitude was only about six kilometres (about 3½ miles). Also, the appearance of cirro-stratus is entirely different from that of alto-stratus. Cirro-stratus is feathery, like real cirrus, whilst alto-stratus is the thick grey pallium through which we see the "watery" sun or moon, which is so frequently a precursor of rain.

D. W. HORNER, F.R.Met.Soc.

Tunbridge Wells, Aug. 23rd, 1922.

Shallow East Winds.

THE following observations were noted on the Western and King's Esplanades, Hove.

At 11h. on Friday, July 21st, 1922, there was a gentle easterly breeze at 25 ft. above the sea, at 50 ft. it was south-easterly, but the coastguard vane, about 85 ft. high, was steady at south-west. There were light cumulus clouds at no great height above it, the smoke from the Portslade gas works chimneys, a mile distant to the west, also came from south-west, while the upper clouds, broad bands of cirrus, lay from south-south-west to north-north-east. No change took place until about 14h. 30m. when the surface wind became very feeble, the direction being unsteady between east and south-east.

Some two months ago a similar phenomenon was witnessed from the coastguard station (at the end of the esplanade), where a light easterly breeze was blowing. At about 11h. a pleasure steamer left the Brighton West Pier on a south-west course, her smoke not ascending above the funnel, but drifting, at one uniform level, in a continuous, sharply defined line from west-south-west towards east-north-east across eastern Brighton. When the steamer reached a point due south of the Hove coastguard station the smoke quickly backed round, and in less than a minute it was going in an equally well-defined line from east-south-east towards west-north-west, across Portslade, the two smoke lines remaining visible for some time, and attracting considerable attention.

In both cases the easterly wind layer would appear to have been less than 80 feet in thickness from the water.

H. HARRIES.

2, Wish Road, Hove, July 31st, 1922.

Simple Weather Forecasting.

WHEN "H." suggests "guessing" in his remarks, anonymity shows lack of courage. I enclose my last "guess" for the month of July. When "H." can "guess" as well he will be qualified to criticise."

From *Evesham Journal*, July 8th, 1922 :—

> "Mr. W. M. Robertson, of The Longacre, Cheltenham, sent the following rough forecast for July,—'Very variable and unsettled with heavy rain at times, next change 11th to 13th and 25th to 27th, bad weather probably between 3rd and 7th and after next change. Any shift of wind to eastward is nearly certain to be followed by very severe thunderstorms. At the end of the month and beginning of August I anticipate a very bad time. After 7th to 9th August improving prospects for the harvest.'
>
> "This forecast was written on July 3rd, and on July 6th Mr. Robertson wrote :—'The same forecast holds good, with the exception that a strong thundery tendency will prevail during the week end, and these storms will probably be of a tidal nature and affect certain areas much more than others.'"

I should like to add that all or nearly all my Forecasts go to Dundee, Yorkshire, Evesham and Tunbridge Wells and are published in papers in those districts. They are therefore still published in Kent and Sussex, so "H's" final "gibe" misses its mark. The period which "H." took for his criticism was "The May Weather Period," always difficult to forecast and generally bad.

May I also mention that in the *Kent and Sussex Courier* for May 12th, 1922, there appeared the following forecast?—

> "The general outlook for the summer is mostly fine and warm in June; rather wet and unsettled throughout July and the early part of August. Fine harvest weather after the middle of August."

W. M. ROBERTSON.

July, 1922.

Earwigs and Recording Instruments.

CAN any of your readers suggest a way of keeping earwigs out of recording instruments? They have proved very troublesome for some weeks—the clocks of the anemometer and the hyetograph have each been stopped twice, the float rod of the hyetograph has stuck, the pen has been overbalanced and fallen off the chart—all owing to earwigs. Moreover, they crawl from the anemometer pens on to the chart carrying a quantity of ink with them. I have tried Keating's powder, eucalyptus oil, and naphtheline balls, but the trouble is not completely overcome.

C. J. P. CAVE.

Stoner Hill, Petersfield, August 19th, 1922.

NOTES AND QUERIES.

Climatological Stations in Scotland.

OUR knowledge of the climatology of Scotland has hitherto depended largely on the work of voluntary observers, and the co-operation of such observers will always be welcome. But with the passage of time the domestic or other circumstances of any station inevitably change, and it is nowadays more difficult than formerly to secure continuity. Quite recently three of the oldest and most important of the Scottish climatological stations have come to an end, and it is interesting to note how the resulting situation has been dealt with in each case.

At ARBROATH a climatological station had for long been in operation under the auspices of the local Natural History Society. The work depended entirely on the enthusiasm of two or three individuals, and in 1921 Mr. James Campbell, who had observed for 30 years, found himself unable to continue or to find a successor. It was represented to the Town Council of Arbroath that the securing of an adequate representation of the climate of their area should be regarded as a municipal obligation. The Town Council accepted this point of view, and a new station was organised on an excellent site on the outskirts of the town, with a municipal employé, in this case the Superintendent of Cemeteries, as observer.

At the High School, INVERNESS, observations had been made since 1881, and this station was almost unique in Scotland, strengthened as it was by a small endowment fund provided by the family of the late Arthur Forbes of Culloden. Forbes was one of the most vigorous of the pioneers of meteorology in Scotland, and had maintained an elaborate set of observations at Culloden for some fifteen years before the foundation of the Scottish Meteorological Society in 1856. The Culloden series (1841–1880) and the Inverness series (1881–1910) may be regarded as practically homogeneous, as the two places are only about three miles apart and in the same climatic zone. For many years the work at the High School was of a high standard, but latterly increasing difficulty was experienced in making arrangements during vacations, and observations were discontinued at the end of 1921. In this case also the Town Council accepted responsibility, jointly with the Forbes Meteorological Trust, and a new station was established on municipal property two miles to the south of Inverness with the Sanitary Inspector as observer.

The closing of the GLENCARRON station about four months ago was a serious matter from the point of view of Official Meteorology as it served as District Value station and provided our only source of information regarding a large and most interesting area. The Glencarron estate constitutes a large deer forest in a thinly populated part of West Ross-shire, and observations were made from 1884 onwards, first by D. Munro and then by D. D. Munro, head stalkers on the estate. Recently the property changed hands and observations were discontinued. The problem of replacing Glencarron might have remained unsolved, had not the Forestry Commission (Scotland) happened to have an afforestation area at ACHNASHELLACH, about two miles to the west. Arrangements have now been completed for a station at that place, with the District Forester as observer.

The action in each of these three cases has been taken in pursuance of the definite policy of transferring the responsibility for a station to some public authority. The prospects of continuity are thus greatly increased, and other changes on these lines are under consideration. Again, in order to secure uniformity in observing and a high standard of work the person appointed as observer at each of the three stations noted above attended at either Eskdalemuir or Aberdeen Observatory for a short course of training. This is a new departure, and a similar arrangement was made in the case of the recently opened "Health Resort" station at NORTH BERWICK.

At both Achnashellach and Inverness the observing hours will be 9h. and 18h. It will probably be found impossible in other cases also to insist on the less convenient times (9h. and 21h.) hitherto usual at a Second Order station.

Meteorological and Wireless Station for Greenland.

At a meeting of members of the International Meteorological Committee, held in London in July 1919, the importance of obtaining meteorological information from Greenland for use in daily weather forecasting was emphasised, and it was agreed that the views of the members should be communicated to the Danish Government.

At subsequent meetings of the Commission for Weather Telegraphy, the importance was urged of establishing a wireless station in the South of Greenland, even if it were only powerful enough to communicate with Iceland and not direct with the Continent of Europe.

It is now understood that an expert, sent by the Danish Government, left for Greenland early in August in order to study the local conditions, so that the Government may be in a position to come to a definite decision on the question of establishing a meteorological and wireless station in Southern Greenland.

Upper Air Reports from Egypt.

ARRANGEMENTS have recently been made by which aeroplane flights are carried out daily by the Royal Air Force in Egypt for the purpose of obtaining records of upper air temperature and humidity in that country. These flights are made at Ismaliah in Lower Egypt and the results are cabled to this country by the Meteorological Service of Egypt with the daily report from Cairo.

As little information concerning upper air temperature has formerly been available from Egypt, these observations are of considerable interest.

As with the observations in England the system adopted is to report the temperatures corresponding with specified pressures. The heights can be worked out if required. The fallacy of using an altimeter graduated for some conventional temperature is avoided.

The following report summarising the results obtained in May last has been prepared by Mr. E. V. Newnham.

Note on the Upper Air Reports from Egypt for May, 1922.

By E. V. Newnham, B.Sc.

The observations discussed are those made between April 30th and May 26th.

During the month of May the mean temperature differed very little from the normal at the surface over Egypt and the northern part of the Sudan. The means for temperature in the free atmosphere given in the following table (based on observations for sixteen days) may, therefore be, assumed to represent normal conditions to a first approximation:—

TABLE I.—MEAN VALUE of TEMPERATURE and RELATIVE HUMIDITY for MAY.

Pressure (millibars).	1,014	1,000	950	900	850	800	750	700	650
Approximate height (ft.)	Surface.	400	1,840	3,340	4,900	6,520	8,200	9,920	11,700
Temperature (°F.)	75	72	68	65	61	57	50	42	34
Difference from Normal for May in England (° F.).	—	—	21	22	23	24	22	19	17
Humidity (per cent.)	—	62	60	45	33	36	36	42	52

It will be noticed that the mean temperature was fully 20° higher than the normal for England for this month, except at the two lowest pressures, where the difference was smaller. Relative humidity was very low from 850 to 750 millibars, but was much higher at 650 millibars. In order to make it possible to survey at a glance the variations in temperature from day to day, isopleths have been drawn (*see* fig. 1). The following discussion is partly based on information obtained from the *Egyptian Daily Weather Reports*, in which the upper winds are given for Helwan, and partly on the working charts made in the Meteorological Office in London. At the beginning of the period, on April 30th and May 1st, moderate temperatures* were experienced; much warmer conditions, however, had developed by May 2nd, and this warmth reached a maximum on the 4th at pressures between 1,000 and 850 millibars, and on the 5th at 800 and 750 millibars. The temperature changed very little at pressures of 700 and 650 millibars, and indeed during the whole month the variations at these pressures were small. Examination of the charts for an explanation of this hot spell showed that there was a depression over the Eastern Mediterranean on the 3rd, which was over the Delta and Palestine on the 4th, with S to SW wind up to 16,000 feet on these days. Observations of upper wind are lacking for the 5th, but on the 6th the wind was northerly up to 3,300 feet, backing to SW higher up. It had become north-easterly up to 6,600 feet by the 7th. It would seem, therefore, as though the passage of this depression was the cause of a considerable outflow of hot air from the desert, and that this outflow continued for two days afterwards at heights above 3,300 feet.

A prolonged cool period now set in, at the same time that pressure became high over Central Europe. Between the 9th and the 11th much polar air spread southwards behind a deep depression over Finland, and it is not surprising that on 13th and 14th temperature was low at all pressures at Ismaliah.

On the 13th a depression had appeared over the western part of the Mediterranean, and continued there for three days, causing southerly winds over the central part of the Mediterranean. One is tempted at first to refer the considerable rise of temperature that took place at all pressures at Ismaliah between the 14th and 15th to this northward flow of hot

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* A well-developed depression had persisted over the western part of the Mediterranean from the 28th to the 30th of April, causing a considerable flow of air northwards from Africa. Study of the synoptic charts for this period suggests that the air crossing Egypt from NE on the 30th of April and 1st of May seems to have been part of this equatorial air, which must, therefore, have undergone rapid cooling in crossing the Mediterranean.

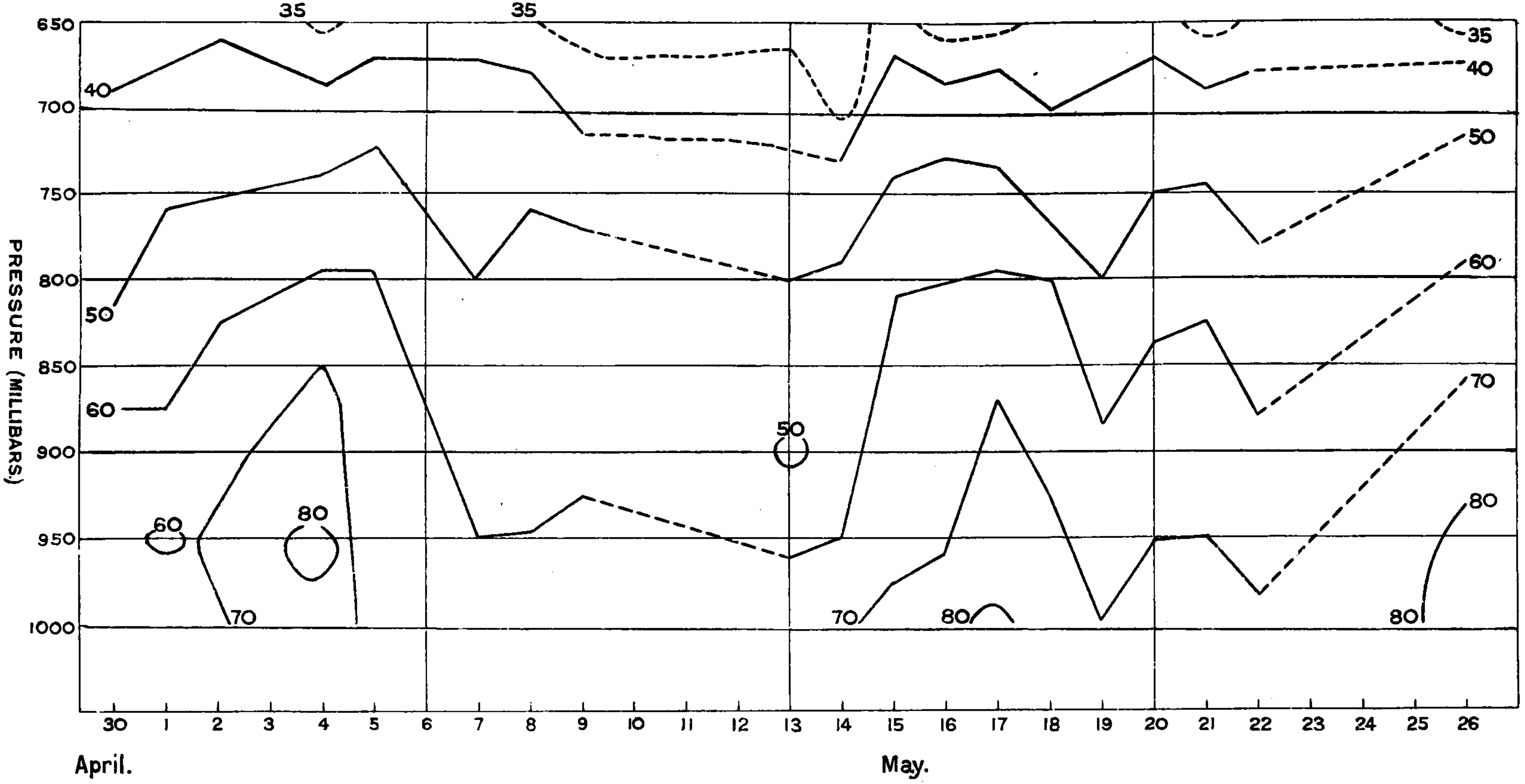

Fig. 1. ISOPLETHS OF TEMPERATURE & PRESSURE FOR ISMALIAH, APRIL 30 TO MAY 26.

H.M. Stationery Office Press Kingsway, W.C.2.
Ps. 22383/574 Wt.63 D.P.1 1000. 8/22

equatorial air, but a small anticlcyone centred just north of the Egyptian coast maintained north-easterly to easterly upper winds from the 13th to the 16th, southerly winds appearing only on the 17th. It would seem more probable that the normal N to NW winds were interfered with for a time, and that the heat was due to their absence rather than to an actual flow of air from the south. On the following day (the 18th) northerly winds prevailed up to 16,000 feet at least, and the temperature aloft declined to a sharp minimum on the 19th.

From the 19th to the 22nd the distribution of pressure favoured northerly winds over the Mediterranean as a whole, an anticyclone persisting over France and depressions eastward and southward of Egypt. Upper winds were northerly or northwesterly at Helwan, but the temperature, partly no doubt as a result of the normal seasonal increase at this time of the year, was rather higher than during somewhat similar local conditions earlier in the month, but also perhaps because there was nothing comparable with the southward flow of polar air that took place over Europe between the 9th and 11th.

Additional observations were made on the 26th, and showed temperatures comparable with those observed during the two previous hot spells. By this time the simple northerly type had broken down, and for the two previous days upper winds had been between south and west. For some days pressure had been falling to the west of Egypt, and an irregular system of low pressure had occupied the whole area from the coast down to the Sudan. Here again, as on the 15th, absence of northwesterly winds and comparative stagnation in the upper air gave rise to high temperature, but the distribution of pressure was dissimilar in the two cases.

The summary of the weather for May issued as a supplement to the *Egyptian Daily Weather Report* notes that the weather was of a settled nature with an absence of Khamsîn winds. It is to be presumed, therefore, that the month of May would often give higher temperatures in the upper air than those observed on this occasion. Whether, on the other hand, one would often encounter a distribution of pressure over Europe more favourable for low temperatures in Egypt than that which set in on the 9th, appears more doubtful.

Weather Reports from Amundsen's Expedition.

From October 15th the observations taken on board Amundsen's ship the *Maud* will be included in the collective message broadcasted by wireless from the Eiffel Tower daily at 11h. 30m. G.M.T. These reports from the *Maud* will be similar to the American reports noted in the July issue but they will include, in addition, the ship's position.

Zone Time.

It is well-known that local time differs in different parts of the globe owing to the rotation of the earth about its axis in 24 hours. As the surface is divided into 360 degrees of longitude there will be a difference of one hour between places 15° apart. Formerly there was no systematic treatment of time measurement, all places keeping their own local time. With the increasing importance of time in daily life and particularly with the advent of railways, the disadvantage of this method became obvious, and a practice arose on the part of the railways of using the time of some central or important city on the line for all places not too distant from it. In countries which did not extend too greatly in longitude it was natural to use the time of the capitals throughout all or a large part of their extent. Greenwich being the national time-keeping observatory of Great Britain, as well as the point from which longitudes all over the world were usually reckoned, Greenwich time was selected as our standard. Inconvenience was still felt in passing from one country to another and in making long journeys across extensive countries such as the United States.

The idea of zone time originated with Dowd, of Saratoga, in 1870. Thirteen years later, four time-zones were established in North America, differing by five, six, seven and eight hours respectively from Greenwich Mean Time. The conception of zone time is two-fold. It is a uniform time over a region corresponding approximately to 15° of longitude and it differs from Greenwich Mean Time by an integral number of hours (in a few cases half-hours). The system has been gradually extended, and, with the exception of Russia, the Argentine and a large part of Asia, the regions which have not adopted zone time, based on their longitude, are very restricted. It is proposed in this magazine to note future alterations in this respect as they occur. The most recent changes are (1) Cyprus, for which zone time 2 hours in advance of Greenwich was adopted on November 14th, 1921. The time previously used was 2h. 12m. fast. (2) Nauru, Pleasant Isles, for which zone time 11h. in advance of Greenwich was adopted on August 22nd, 1921. The time previously used was 11h. 8m. fast.

Twin Hurricanes in the Atlantic.

In September, 1921, between the 7th and 15th, two hurricanes traversed the region between Trinidad and Bermuda. The centres of the two depressions kept about 800 miles apart for some days.

A discussion of the observations by Commander L. A. Brooke Smith, R.N.R., Marine Superintendent, is given on the back of the Meteorological Chart of the North Atlantic, September, 1922.

Heavy Rain at Alverstoke, Hants.

An account of a heavy fall of rain at Alverstoke on August 11th, 1922, has been received from Major J. Blake. He writes that the day was cloudy and murky, with light variable winds. A rather heavy shower (about ·15 in.) fell between 10 and 11 a.m. About 1 p.m. heavy, soft clouds spread in from westward and very heavy rain fell from 1.20 to 2.10 p.m., being exceptionally heavy between 1.30 and 2 p.m. The severity of the fall may be gathered from the fact that the rain poured off a flat verandah roof (about 4 ft. 6 ins. from the ground) and rushed down the path with sufficient force to deposit a heap of gravel, a foot high, on the lawn. Lawns were flooded to a depth of one or two inches and in the walled garden most of the fine soil was washed off the beds.

The reading of the rain gauge was 1·86 in., and for the 24h. ending 9 a.m. on the 12th, 1·88 in. A gauge about 250 yards to the north-west recorded 2·10 in. and 2·12 in. for the 24h.

The storm which seemed to travel out to sea appears to have been very local, places only a mile or two to the north and north-west having much less heavy rain. The *Daily Weather Report* for August 12th reports only 10 mm. (·39 in.) at Portsmouth, 2½ miles north-east of Alverstoke and only a " trace " at Calshot, 9 miles to the north-west.

Major Blake has also sent a cutting from the yachting notes in the *Field* of August 19th which confirms his observation that the storm went out to sea.

> " Towards the end of the race off Spithead, out of a dense black cloud northerly there came a sudden squall of rain, and a good deal of wind with it; the rain was blinding, and ran off the mainsails of the yachts in torrents . . . the sea smooth, beaten down by the rain in the fury of the squall . . . but it was soon gone, leaving us lolling in a paltry calm, the sails too water-logged to catch the breeze "

Compensation for a Wet Holiday.

The *Daily News* has inaugurated a scheme of compensating for a wet holiday. During the first two weeks of August £500 per week was to-be allocated to the 330 readers who suffered most on their holidays from heavy rainfall. The payments were to be based on the measurements recorded at the nearest town given in the official list of the Meteorological Office or on well authenticated local records of rainfall which the editor could accept as accurate. The rules do not appear to have been drawn up with any regard to the hours at which rainfall is nominally measured and arbitration on the claims of various readers must have presented considerable difficulty.

Radiation from the Sky.

RADIATION MEASURED AT BENSON, OXON, 1922.

Unit : one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays).

Averages for Readings about time of Sunset.

		April.	May.	June.
Cloudless days :—				
Number of readings	n	15	25	18
Radiation from sky in zenith	πI	439	530	555
Total radiation from sky	J	477	568	592
Total radiation from horizontal black surface on earth.	X	705	767	798
Net radiation from earth	X–J	228	199	206

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

Cloudless days :—				
Number of readings	n_0	7	9	6
Radiation from sky in zenith	πI_0	23	37	37
Total radiation from sky	J_0	32	39	34
Cloudy days :—				
Number of readings	n_1	8	9	10
Radiation from sky in zenith	πI_1	620	688	736
Total radiation from sky	J_1	643	705	737

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

Norwegian Daily Weather Reports.

FROM January 1st, 1922, a new series of charts has been issued by the Bergen Division of the Norwegian Meteorological Institute. The charts, which are issued twice a day, at 8h. and 19h., are synoptic weather maps drawn in accordance with Professor Bjerknes' theories and show the " warm fronts," " cold fronts " and " occluded fronts " found by analysis of the observations. The affixed text gives information about the situation and the features upon which the analysis has been based.

Reviews.

Deux Théorèmes Fondamentaux de la Dynamique de la Mer. Traité élémentaire experimental. By J. W. Sandström. Ur Svenska Hydrografisk-Biologiska Kommissionens Skrifter, VI. Stockholm, 1921. 18 × 12½. pp. 6, *illus.*

HYDROGRAPHICAL observations show that the behaviour of stratified masses of water such as the sea, under the influence of exterior forces due to the wind or the earth's rotation, is such that an interchange of particles between strata of different density, *i.e.*, mixing of the strata, takes place so slowly that it may be disregarded over long periods so that, for instance, discontinuities once in existence persist for a long time. On the other hand, should any cause, such as the addition or abstraction of heat or the fusion of ice, operate to produce a change of density at any point then the stratification is upset, the affected water seeking a fresh stratum corresponding to its new density. These results are embodied by the author in two theorems enunciated at the beginning of the present publication, which is then devoted to a description of experiments, carried out on a laboratory scale, in illustration of them, and to the application of the principles to a number of cases in nature.

One of the experiments shows, for example, how, in a fluid with several strata of finite thickness, the wind sets up a circulation about a horizontal axis which is limited to the uppermost stratum, while an opposite circulation may be imparted to the adjacent stratum by friction at the interface, and so on. The junctions between the strata become inclined and the motion set up is much more complicated than in a homogeneous fluid.

Other interesting experiments demonstrate the currents set up by the melting of ice floating in water and also by a source of heat and a source of cold placed in various relative positions, and the significance of these is discussed in connection with the maintenance of large ocean currents, such as the Gulf Stream, the causes of which lie in physical changes in the condition of the water.

One point of practical importance may be cited. It is shown how the homogeneity of the waters of the Labrador current permits of the superimposition of a marked circulation about a horizontal axis giving the surface waters a strong component towards the rocky east and south coasts of Newfoundland, and this, combined with low visibility due to fog, is responsible for frequent shipwrecks in those regions.

As the title indicates, the treatment is elementary, but the paper, which is amply illustrated by diagrams, is very interesting reading.

M. A. G.

Rio de Janeiro, Ministerio da Agricultura, Industria e Commercio ; Directoria de Meteorologia. Boletin de Normals. Observacões meteorologicas feitas no ex-Observatorio Nacional hoje Instituto Central do Rio de Janeiro, e nas Estacões da rêde Nacional. 1922. 4°. pp. viii. + 66.

AMONG the first fruits of the reorganisation of the Brazilian Meteorological Service under the energetic leadership of Señor Sampaio Ferraz (see this Magazine, 1921, pp. 225, 334) we welcome the publication of a collection of normal climatological values for Rio de Janeiro and for a large number of stations of the second and third order, besides rainfall stations. For Rio de Janeiro the monthly figures are given year by year for all elements from the beginning of reliable observations, in most cases 1890, until 1920, with daily normals of temperature and rainfall from 1882. For the provincial stations the normals cover periods ranging from five to twenty-four years ending in 1919 and include all elements, with remarkably complete series of phenomena. The great majority of these stations were established by the old Directoria de Meteorologia e Astronomia between 1909 and 1914, and the observations are all on a uniform system, with one curious exception, which refers to the thermometer screens. At the second order stations the type of screen is similar to that in use in Mexico (two louvred screens one within the other, surmounted by an overhanging gable top)* but smaller and better ventilated, while stations of the third order employ a large type of Stevenson screen. Tests carried out with the aid of an aspirated thermometer show that the former screen gives retarded and exaggerated maxima and the daily mean temperature at second order stations has therefore been calculated from the formula $\frac{1}{4}(7hr + 14hr + 2 \times 21hr.)$, while at third order stations the formula $\frac{1}{4}(7hr + 21hr. + \text{Max.} + \text{Min.})$ has been used. It is also stated that the rain gauges are usually placed on high pillars, and the quantity of rain registered is therefore too small.

As the first extensive series of normals from Brazil, this publication will be of very great value to meteorologists. It appears to have been prepared with great care and becomes at once the standard source of information as to the climate of Brazil. Incidentally, the list of errata is at the end, and should be consulted before the figures are utilised.

May we hope, moreover, that when time permits Señor Sampaio Ferraz will utilise his own knowledge of local conditions in interpreting the figures for us by means of a series of charts to supplement the present volume?

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* See *Rio de Janeiro, Ministerio da Agricultura. Instruccões meteorologicas, por J. de Sampaio Ferraz.* 1914. Vol. 1, p. 70.

News in Brief.

WE regret to announce the death, on September 3rd, of Mr. Leslie Stuart Priestley, Junior Professional Assistant of the Meteorological Office, stationed at Shoeburyness.

A PAPER on "Germany's Climate" will be read by Dr. Sven Hedin at the Centennial Festival of the Gesellschaft Deutscher Naturforscher und Artze, September 18th–24th, 1922.

NEWS is received that the sunshine record from Birr Castle has been interrupted. Rebel forces were sniping from the top of the Rosse telescope, and the necessary removal of the stairs has rendered the recorder inaccessible for the present.

Errata.

June 1922, page 192, line 19, "our Celtic spring begins on February 2nd" *should read* "the old Celtic spring began on February 2nd."

August 1922, page 186, paragraph 4, line 6, *for* "−0·34" *read* "−0·35," *and for* "±0·57" *read* "±0·58."

August 1922, page 202, paragraph 6, line 4, *for* "100 mm. (2 in.)" *read* "100 mm. (4 in.)."

The Weather of August, 1922.

August, like the preceding month, proved to be cool and unsettled in north-west Europe. At the beginning of the month there was a depression between Iceland and the Faröe Islands, while an extensive anticyclone stretched from the Azores to France. On the 1st, local disturbances caused heavy rain and thunderstorms in Switzerland, Berne recording 46 mm. of rain in the 24 hours. The Icelandic depression moved north-eastward and the Azores anticyclone eastward. By the 4th the latter was over Central Europe and pressure had become high in Iceland, with the result that the Atlantic depressions took a more southerly course.

On the 6th a depression appeared over the mouth of the English Channel and moved north-eastward across England. This was followed by the appearance of a second disturbance off the south-west coasts, which also moved north-eastward and joined up with the first centre over the North Sea. These disturbances caused thunderstorms and notably heavy rain in England, particularly in the Midlands and the North, where extensive floods caused much damage. More than 50 mm. (2 inches) appears to have fallen on the 6th over a strip extending from Swanage to Worksop, and on the 7th in the south of Yorkshire. Between midnight and 16 h. on August 7th no less than 99·5 mm. (3·92 in.) of rain fell at Sheffield, which, with a further 8 mm. (·32 in.) between 16 h. on the 7th and 3 h. on the 8th, gave a total of 107·5 mm. (4·24 in.) in 27 hours. At Strelley Hall, Nottinghamshire, 82 mm. (3·23 in.) of rain was measured in 21 hours, while Harrogate had 123 mm. (4·84 in.) in three days. At Hodsock Priory, near Worksop, rain commenced at 23 h. on August 6th and ceased at 3 h. on the 8th, 125 mm. (5·06 in.) falling in this period. From 9 h. to 11 h. 15 m. on 7th 50 mm. (1·97 in.) fell.

As these disturbances moved eastward, a ridge of high pressure spread in over the British Isles from the Atlantic, and by the 11th this was stretching from the Azores to Spitzbergen. This split up into two " highs," one over the Spitzbergen region and one over the Azores. A new depression appeared in the vicinity of Iceland and moved eastward, keeping north of the British Isles. This type of distribution continued for some days with depressions passing to the north of Britain and maintaining generally unsettled weather in north-west Europe.

On the 14th, a shallow area of low pressure over France moved eastward and caused heavy rains and thunderstorms locally, Frankfurt measuring 71 mm. in 24 hours. About this time high temperatures were registered in the south of France, Toulouse reaching 95° F. on the 13th and Lyons 93° F. on the 14th. Conditions in western and central Europe now became more settled under the influence of a " high " over Germany and an eastward extension of the Azores anticyclone. On the 21st the maximum temperature at Bayonne reached 101° F.

On the 22nd a depression over Iceland moved in a south-easterly direction, and by the 23rd was over Denmark, causing a renewal of very unsettled conditions over west and north-west Europe. Rainfall was very heavy in parts of Germany, Scandinavia and Denmark. This system moved north and filled up, but further depressions advanced from the Atlantic, and by the 28th a trough of low pressure stretched from Iceland to Spain, and, spreading further eastward, maintained unsettled weather to the end of the month. On the 30th a small secondary disturbance caused 79 mm. of rain at Berne. W. C. K.

A violent thunderstorm occurred over the neighbourhood of Lyons on the 7th. A large part of the town was plunged in darkness by the destruction of the Jonage Electric Works by lightning. As nearly all the local factories depended on these works for power and light, hundreds of persons were thrown out of employment.

At the middle of the month, southern France experienced a spell of hot weather, and a shade temperature of 98·6° F. was registered at Toulon. Many forest fires broke out, thousands of acres of woodland being involved. Between the 14th and 16th violent hailstorms occurred in the Meuse and Saône-et-Loire Departments, followed by an extremely severe one in the Charolle district (Saône-et-Loire), in the course of which cattle were killed and many large trees uprooted.

On the 2nd, hailstorms were experienced over wide areas of Switzerland, much damage being caused in the Cantons of Vaud, Berne and Appenzell.

Two ships were lost near Gibraltar during a dense fog which covered the Straits on the morning of the 6th.

After the first week of August very hot weather was experienced in Italy, associated with high pressures over central or eastern Europe. In Rome and in the Umbrian Hills the shade temperature frequently exceeded 100° F.; on the 12th 112° F. is said to have been registered at Foggia, near Bari, on the Adriatic, the highest temperature known in Italy for the past half-century. Exceptional heat was also felt in other Mediterranean countries and forest fires broke out in southern France, Algeria, Sardinia, Greece.

A pronounced break occurred in the Indian monsoon and the first half of the month was almost rainless in central and north-west India and the northern Deccan. Certain regions, however, had normal and even excess rainfall, the latter occurring mainly on the Madras coast and in Bengal and Burma. On the 9th extensive floods were reported from Rangoon, involving the temporary cutting off of Upper from Lower Burma, and on the 14th over one hundred square miles of the Midnapore district of Bengal were inundated. Heavy rain also fell in Waziristan (eastern Afghanistan). One storm occurred in the Bay of Bengal.

Further details are available of the great typhoon which wrecked Swatow, on the Han River delta in southern China, on the 2nd, and which was briefly reported in last month's issue. The loss of life in the delta, which contain many populous towns, is now estimated as at least 50,000. There were two typhoons, of which the second was the more severe, being accompanied by thunder, torrential rain and a large tidal wave which carried everything before it. The wind reached a velocity of over 100 miles per hour. All shipping was wrecked and one motor-boat was found five miles inland. Apart from the severity of the typhoon, its early date was a noticeable feature, the season not usually beginning on this part of the coast until the end of August.

The hot weather experienced in Japan and in the hinterland of northern China during July continued in August. Daily shade temperatures frequently exceeded 100° F. and on several occasions

(*Continued on p.* 230.)

Rainfall Table for August 1922.

STATION.	COUNTY.	Aver. 1881—1915.	1922.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	2·21	2·54	65	115	·55	6	17
Tenterden (View Tower)	*Kent*	2·29	2·27	58	99	·57	9	19
Arundel (Patching Farm)	*Sussex*	2·52	2·46	63	98	·43	6	14
Fordingbridge (Oaklands)	*Hampshire*	2·63	5·81	148	221	2·38	6	20
Oxford (Magdalen College)	*Oxfordshire*	2·25	5·11	130	227	2·82	6	16
Wellingborough (Swanspool)	*Northampton*	2·38	5·32	135	224	3·05	6	19
Hawkedon Rectory	*Suffolk*	2·59	2·06	52	80	·37	7	16
Norwich (Eaton)	*Norfolk*	2·37	1·54	39	65	·35	3	17
Launceston (Polapit Tamar)	*Devon*	3·18	3·08	78	97	·73	8	22
Sidmouth (Sidmount)	„	2·81	3·77	96	134	1·37	6	17
Ross (County Observatory)	*Herefordshire*	2·56	2·76	70	108	·54	7	17
Church Stretton (Wolstaston)	*Shropshire*	3·25	2·65	67	82	·49	12	17
Boston (Black Sluice)	*Lincoln*	2·39	1·81	46	76	·30	6	15
Worksop (Hodsock Priory)	*Nottingham*	2·45	6·50	165	276	3·23	7	15
Mickleover (Clyde House)	*Derbyshire*	2·72	5·66	144	208	1·97	6	15
Southport (Hesketh Park)	*Lancashire*	3·48	5·94	151	155	2·56	31	20
Wetherby (Ribston Hall)	*York, W. R.*	2·73	6·65	169	244	2·45	7	9
Hull (Pearson Park)	„ *E. R.*	2·91	3·19	81	110	1·11	7	13
Newcastle (Town Moor)	*North'land*	2·92	2·62	67	90	·96	8	14
Borrowdale (Seathwaite)	*Cumberland*	11·57	10·00	254	86	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	4·32	4·16	106	96	·68	12	22
Haverfordwest (Gram. Sch.)	*Pembroke*	4·17	5·36	136	129	1·04	8	15
Aberystwyth (Gogerddan)	*Cardigan*	4·87	5·21	132	107	1·29	8	9
Llandudno	*Carnarvon*	3·02	1·45	37	48	·21	12	13
Dumfries (Cargen)	*Kirkcudbrt.*	4·40	3·15	80	72	·35	8	20
Marchmont House	*Berwick*	3·31	2·73	69	82	1·27	8	15
Girvan (Pinmore)	*Ayr*	4·45	2·89	73	65	·36	31	23
Glasgow (Queen's Park)	*Renfrew*	3·54	2·56	65	72	·52	8	22
Islay (Eallabus)	*Argyll*	4·36	5·29	134	121	1·15	26	21
Mull (Quinish)	„	4·91	4·18	106	85	1·00	15	23
Loch Dhu	*Perth*	6·75	5·35	136	79	1·10	6	16
Dundee (Eastern Necropolis)	*Forfar*	3·38	2·96	75	88	1·12	2	17
Braemar (Bank)	*Aberdeen*	3·41	2·82	72	83	·44	22	17
Aberdeen (Cranford)	„	2·88	2·51	64	87	·36	1, 15	22
Gordon Castle	*Moray*	3·17	2·78	71	88	·57	22	16
Fort William (Atholl Bank)	*Inverness*	6·16	4·63	118	75	·96	15	22
Alness (Ardross Castle)	*Ross*	2·95	2·16	55	73	·78	22	18
Loch Torridon (Bendamph)	„	6·60	4·51	115	68	1·03	22	21
Stornoway	„	3·97	4·61	117	116	·74	22	21
Loch More (Achfary)	*Sutherland*	5·84	5·58	142	96	1·21	15	24
Wick	*Caithness*	2·75	2·05	52	74	·39	17	19
Glanmire (Lota Lodge)	*Cork*	3·65	5·02	127	138	1·73	3	18
Killarney (District Asylum)	*Kerry*	4·42	..	..	..	..	..	..
Waterford (Brook Lodge)	*Waterford*	3·83	4·76	121	124	·92	3	19
Nenagh (Castle Lough)	*Tipperary*	3·95	..	..	..	..	..	..
Foynes	*Limerick*	3·86	2·76	70	72	·33	29	28
Gorey (Courtown House)	*Wexford*	3·33	..	..	..	..	..	..
Abbey Leix (Blandsfort)	*Queen's Co.*	3·95	3·49	89	88	·75	29	21
Dublin (FitzWilliam Square)	*Dublin*	3·04	4·23	107	139	1·84	30	19
Mullingar (Belvedere)	*Westmeath*	4·17	5·52	140	132	1·23	4	27
Crossmolina (Enniscoe)	*Mayo*	4·51	..	..	..	..	..	..
Collooney (Markree Obsy.)	*Sligo*	4·35	3·76	95	86	·50	11	24
Seaforde	*Down*	3·75	3·85	98	103	·53	20	19
Ballymena (Harryville)	*Antrim*	4·27	3·80	97	89	·66	29	22
Omagh (Edenfel)	*Tyrone*	4·27	4·49	114	105	1·24	30	21
Letterkenny Asylum	*Donegal*	4·50	3·04	77	68	·47	30	21

Stornoway for July should read 2·56 in., 65 mm.

Supplementary Rainfall, August 1922.

Div.	STATION.	RAIN. in.	RAIN. mm.	Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	..	..	XII.	Langholm, Drove Rd.	5·43	138
"	Sevenoaks, Speldhurst	2·85	72	XIII.	Ettrick Manse	3·75	95
"	Hailsham Vicarage...	3·55	90	"	North Berwick Res....	1·44	37
"	Totland Bay, Aston Ho.	2·51	64	"	Edinburgh, Royal Ob.	1·46	37
"	Ashley, Old Manor Ho.	3·30	84	XIV.	Biggar...............	2·52	64
"	Grayshott...........	3·28	83	"	Leadhills	5·57	141
"	Ufton Nervet........	4·20	107	"	Kilmarnock, Agric.Coll.	3·99	101
III.	Harrow Weald, Hill Ho.	2·91	74	XV.	Dougarie Lodge.......	3·43	87
"	Pitsford, Sedgebrook..	4·99	127	"	Oban................	3·57	91
"	Chatteris, The Priory.	1·51	38	"	Holy Loch, Ardnadam	5·43	138
IV.	Elsenham, Gaunts End	2·77	70	"	Tiree, Cornaigmore....	..	..
"	Lexden, Hill House ..	·97	25	XVI.	Loch Venachar	3·25	83
"	Aylsham, Rippon Hall	1·58	40	"	Glenquey Reservoir ...	4·10	104
"	Swaffham...........	2·24	57	"	Loch Rannoch, Dall...	1·60	41
V.	Devizes, Highclere ...	3·87	98	"	Blair Atholl..........	2·23	57
"	Weymouth..........	2·96	75	"	Coupar Angus....... .	2·07	53
"	Ashburton, Druid Ho.	4·78	121	"	Montrose Asylum	1·85	47
"	Cullompton	4·42	112	XVII.	Logie Coldstone, School	2·50	63
"	Hartland Abbey	3·20	81	"	Fyvie Castle..........	2·27	58
"	Penzance, Morrab Gden.	4·01	102	"	Grantown-on-Spey ...	3·02	77
"	St. Austell, Trevarna.	3·89	99	XVIII.	Kingussie, Fasnakyle..	..	..
"	Crewkerne Merefield Ho	4·41	112	"	Fort Augustus........	2·80	71
VI.	Clifton College	4·74	120	"	Loch Quoich, Loan ...	9·20	..
"	Ledbury, Underdown.	2·59	66	"	Fortrose	1·91	49
"	Shifnal, Hatton Grange	2·73	69	"	Faire-na-Squir........	..	..
"	Ashbourne, Mayfield.	6.37	136	"	Skye, Dunvegan	5·40	137
"	Barnt Green, Upwood	4·19	106	XIX.	Loch Carron, Plockton.	..	..
"	Blockley, Upton Wold	5·67	144	"	Dornoch, St. Gilbert's .	2·13	54
VII.	Leicester, TownHallSq.	4·67	119	"	Tongue Manse	2·75	70
"	Grantham, Saltersford	6·12	155	"	Melvich Schoolhouse ..	3·00	76
"	Louth, Westgate	2·84	72	XX.	Caheragh Rectory	6·50	165
"	Mansfield, West Bank	6·30	160	"	Mitchelstown Castle...	..	..
VIII.	Nantwich, Dorfold Hall	3·34	85	"	Tipperary, The Vale ..	2·79	71
"	Bolton, Queen's Park.	5·77	147	"	Darrynane Abbey	..	..
"	Lancaster, Strathspey.	5·76	146	"	Cashel, Ballinamona...	3·39	86
IX.	Wath-upon-Dearne...	..	..	"	Roscrea, Timoney Park	..	..
"	Bradford, Lister Park.	5·40	137	"	Broadford, Hurdlestown	3·32	84
"	West Witton.........	3·07	78	XXI.	Kilkenny Castle.......	3·86	98
"	Scarborough, Scalby..	3·83	97	"	Rathnew, Clonmannon	4·73	120
"	Middlesbro', Albert Pk.	2·28	58	"	Hacketstown Rectory .	6·18	157
"	Mickleton...........	..	..	"	Balbriggan, Ardgillan .	3·88	99
X.	Bellingham	2·53	64	"	Drogheda	3·99	101
"	Ilderton, Lilburn	1·76	45	"	Athlone, Twyford	..	..
"	Orton...............	4·86	123	XXII.	Castle Forbes Gdns....	4·50	114
XI.	Llanfrechfa Grange ..	3·47	88	"	Ballynahinch Castle...	6·31	160
"	Treherbert, Tyn-y-waun	6·84	174	"	Galway, Waterdale ...	4·13	105
"	Carmarthen Friary ..	4·64	118	XXIII.	Westport House	3·97	101
"	Lampeter, Falcondale	3·58	91	"	Enniskillen, Portora...	..	..
"	Cray Station	4·10	104	"	Crossdoney Kent Cas. .	3·93	100
"	B'ham W.W., Tyrmyndd	3·56	90	"	Armagh Observatory ..	3·84	97
"	Lake Vyrnwy.......	4·13	105	"	Warrenpoint	4·71	120
"	Llangynhafal, P. Drâw	3·29	84	"	Belfast, Cave Hill Rd..	4·35	111
"	Oakley Quarries	8·72	221	"	Glenarm Castle	4·64	118
"	Dolgelly, Bryntirion..	5·25	133	"	Londonderry, Creggan.	3·68	93
"	Snowdon, Llydaw 10.	12·33	313	"	Sion Mills............	3·77	96
"	Lligwy	2·82	72	"	Milford, The Manse ...	3·61	92
XII.	Stoneykirk, Ardwell Ho	3·26	83	"	Narin, Kiltoorish	3·68	93
"	Carsphairn, Shiel.....	5·80	147	"	Killybegs, Rockmount .	4·28	109

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° F.
London, Kew Observatory	1011·8	−2·0	56	3	28	26	46·9	36·7	41·8	−0·2
Gibraltar	1016·6	+0·8	72	6	42	23, 24	63·0	50·5	56·7	−1·3
Malta	1018·5	+4·6	75	23	47	4	64·3	54·5	59·4	+3·2
Sierra Leone	1011·0	+0·1	95	9, 16	73	16, 22	90·8	75·2	83·0	+0·3
Lagos, Nigeria	..	..	..	..	..	..	..	..	..	..
Kaduna, Nigeria	..	..	..	..	..	..	..	..	..	..
Zomba, Nyasaland	1009·8	+0·1	89	18	57	3	82·7	63·3	73·0	+2·3
Salisbury, Rhodesia	1007·8	−3·6	92	19	52	2	85·8	58·4	72·1	+4·0
Cape Town	1014·8	+0·3	100	11	48	22	78·1	59·4	68·7	+0·5
Johannesburg	1013·2	−0·2	82	11	49	1	74·5	54·2	64·3	+1·0
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	..	..	93	2	40	23	84·7	55·1	69·9	+2·5
Calcutta, Alipore Obsy.	1008·2	−1·7	101	29	56	9	96·1	70·4	83·3	+3·2
Bombay	1010·4	−0·3	92	8	67	6	87·4	72·8	80·1	+0·6
Madras	..	..	97	15	66	1	91·4	71·9	81·7	+0·7
Colombo, Ceylon	1011·0	+1·0	91	2	67	1	89·3	73·9	81·6	−0·4
Hong Kong	1015·4	−0·4	77	13	53	1	68·5	61·1	64·8	+1·5
Sandakan	..	..	88	24, 25	72	13	85·7	74·9	80·3	−0·8
Sydney	1014·5	−1·7	92	18	51	26	79·1	60·6	69·9	+0·7
Melbourne	1016·0	−1·0	95	18	46	23	73·3	53·6	63·5	−1·0
Adelaide	1017·4	+0·4	100	17	49	25	81·7	56·5	69·1	−0·8
Perth, Western Australia	1013·7	−1·7	106	14	52	27	83·3	61·8	72·5	+1·6
Coolgardie	1013·4	−1·4	105	8	50	22, 23	88·8	60·6	74·7	+3·0
Brisbane	1014·8	+0·7	93	19	60	16	83·9	65·4	74·7	+0·3
Hobart, Tasmania	1010·9	−3·1	86	18	45	27	66·9	50·4	58·7	−0·7
Wellington, N.Z.	1004·4	−12·6	75	9	44	6	67·2	53·2	60·2	−0·5
Suva, Fiji	1008·5	0·0	90	11	69	24	86·9	71·9	79·4	−0·7
Kingston, Jamaica	1015·6	+0·6	89	12	65	2	86·7	67·9	77·3	+0·2
Grenada, W.I.	1014·9	+2·0	87	23, 24	68	11	82·2	71·6	76·9	−0·8
Toronto	1019·2	+2·2	58	14	13	18	41·8	26·7	34·3	+5·4
Winnipeg	1018·0	−0·8	49	13	9	28	33·4	16·0	24·7	+10·3
St. John, N.B.	1015·9	+1·7	54	29	−1	2	38·5	24·0	31·3	+2·9
Victoria, B.C.	1014·4	−1·4	56	29	33	21	48·0	36·7	42·3	−0·9

London, Kew Observatory.—Prevailing wind direction NE, mean speed 11·1 mi/hr. 6 days with snow, 1 day with hail, 1 day with thunder heard.

Gibraltar.—Prevailing wind direction W. 3 days with gale.

Malta.—Prevailing wind direction westerly. 5 days with hail, 1 day with thunder heard.

Sierra Leone.—Prevailing wind direction SW. 6 days with harmattan.

Salisbury, Rhodesia.—Prevailing wind direction easterly.

Colombo, Ceylon.—Prevailing wind direction WSW, mean speed 3·9 mi/hr. Sea breeze by day, light wind at night. 2 days with thunder heard.

British Empire, March 1922.

TEMPERATURE				PRECIPITATION				BRIGHT SUNSHINE		
Mean	Absolute	Relative Humidity	Mean Cloud Am'nt	Amount		Diff. from Normal	Days	Hours per day	Percentage of possible	STATIONS
Wet Bulb.	Min. on Grass									
° F.	° F.	%	0–10	in.	mm.	mm.				
39·2	21	76	7·0	1·69	43	0	15	2·9	25	London, Kew Observatory.
52·3	37	77	4·6	2·81	71	− 51	14	..	..	Gibraltar.
53·9	41	75	4·3	0·38	10	− 25	5	8·4	71	Malta.
73·5	..	61	1·9	0·00	0	− 28	0	..	..	Sierra Leone.
..	..	..	..	..	..	..	..	..	..	Lagos, Nigeria.
..	..	..	..	..	..	..	..	..	..	Kaduna, Nigeria.
..	..	83	5·1	2·01	51	−159	13	..	..	Zomba, Nyasaland.
63·6	..	60	2·0	2·08	53	− 54	6	..	..	Salisbury, Rhodesia.
63·1	..	67	3·5	0·57	14	− 10	3	..	..	Cape Town.
55·7	44	73	5·1	4·96	126	+ 19	15	8·1	66	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
56·6	..	52	1·9	0·11	3	− 98	3	..	..	Bloemfontein.
70·4	45	35	0·6	0·02	1	− 31	0*	..	..	Calcutta, Alipore Obsy.
71·6	55	61	0·6	0·00	0	− 1	0*	..	..	Bombay.
74·4	62	70	0·6	0·00	0	− 5	0*	..	..	Madras.
77·2	62	60	4·6	1·63	41	− 71	5	..	..	Colombo, Ceylon.
60·7	..	81	8·5	3·67	93	+ 17	9	3·1	26	Hong Kong.
76·9	..	85	..	13·32	338	+132	15	..	..	Sandakan.
64·7	41	63	3·4	1·66	42	− 88	6	8·4	68	Sydney.
57·5	39	57	5·0	0·43	11	− 46	5	..	..	Melbourne.
57·4	36	43	3·3	0·13	3	− 23	2	9·0	74	Adelaide.
63·1	43	51	2·9	0·19	5	− 13	4	9·4	76	Perth, Western Australia.
62·9	..	36	2·5	2·67	68	+ 49	4	..	..	Coolgardie.
68·9	58	67	2·9	2·01	51	− 99	10	..	..	Brisbane.
52·1	39	61	5·8	0·65	17	− 26	13	7·0	56	Hobart, Tasmania.
55·3	34	72	6·6	6·81	173	+ 90	15	5·8	47	Wellington, N.Z.
77·5	..	87	6·6	29·52	750	+377	24	..	..	Suva, Fiji.
..	..	73	5·7	0·82	21	− 5	6	..	..	Kingston, Jamaica.
72·0	..	74	4·7	5·16	131	+ 61	21	..	..	Grenada, W.I.
29·5	9	69	4·6	3·06	78	+ 11	14	..	..	Toronto.
23·1	..	92	5·0	1·34	34	+ 7	4	..	..	Winnipeg.
28·4	−1	73	4·9	3·29	84	− 31	10	..	..	St. John, N.B.
38·4	25	81	0·6	1·23	31	− 34	16	..	..	Victoria, B.C.

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

Hong Kong.—Prevailing wind direction E, mean speed 14·6 mi/hr. 1 day with fog.

Sandakan.—Prevailing wind direction NE.

Perth, W.A.—Prevailing wind direction SSW, mean speed 11·8 mi/hr. Absolute max, record for March.

Wellington, N.Z.—Prevailing wind direction NW.

Suva, Fiji.—Calms predominate. 6 days with thunder heard.

Grenada, W.I.—Prevailing wind direction E. 1 day with thunder heard.

(*Continued from p.* 225.)

reached 115° F. in Tientsin and Pekin. The Japanese cruiser *Nitaka* sank in a typhoon off the Kamchatka coast on the 26th.

Transatlantic steamers have reported many icebergs in the North Atlantic, and the Cunard liner *Antonia* was delayed for eighteen hours by fog off the Banks of Newfoundland.

The weather has continued very favourable for the Canadian crops which are expected to exceed the famous results of 1915. Even the Manitoba section, which suffered tremendous damage from hail in June, has recovered. Satisfactory rain fell in British Columbia during the month.

The report of the United States Weather Bureau dated August 9th states that the drought was continuing in the western section of the cotton belt, with intensely hot weather in Oklahoma. Light rains prevailed over most of the central and eastern sections.

On the 4th it was reported that heavy rains had caused extensive floods in Southern Chile with great damage to property and agriculture.

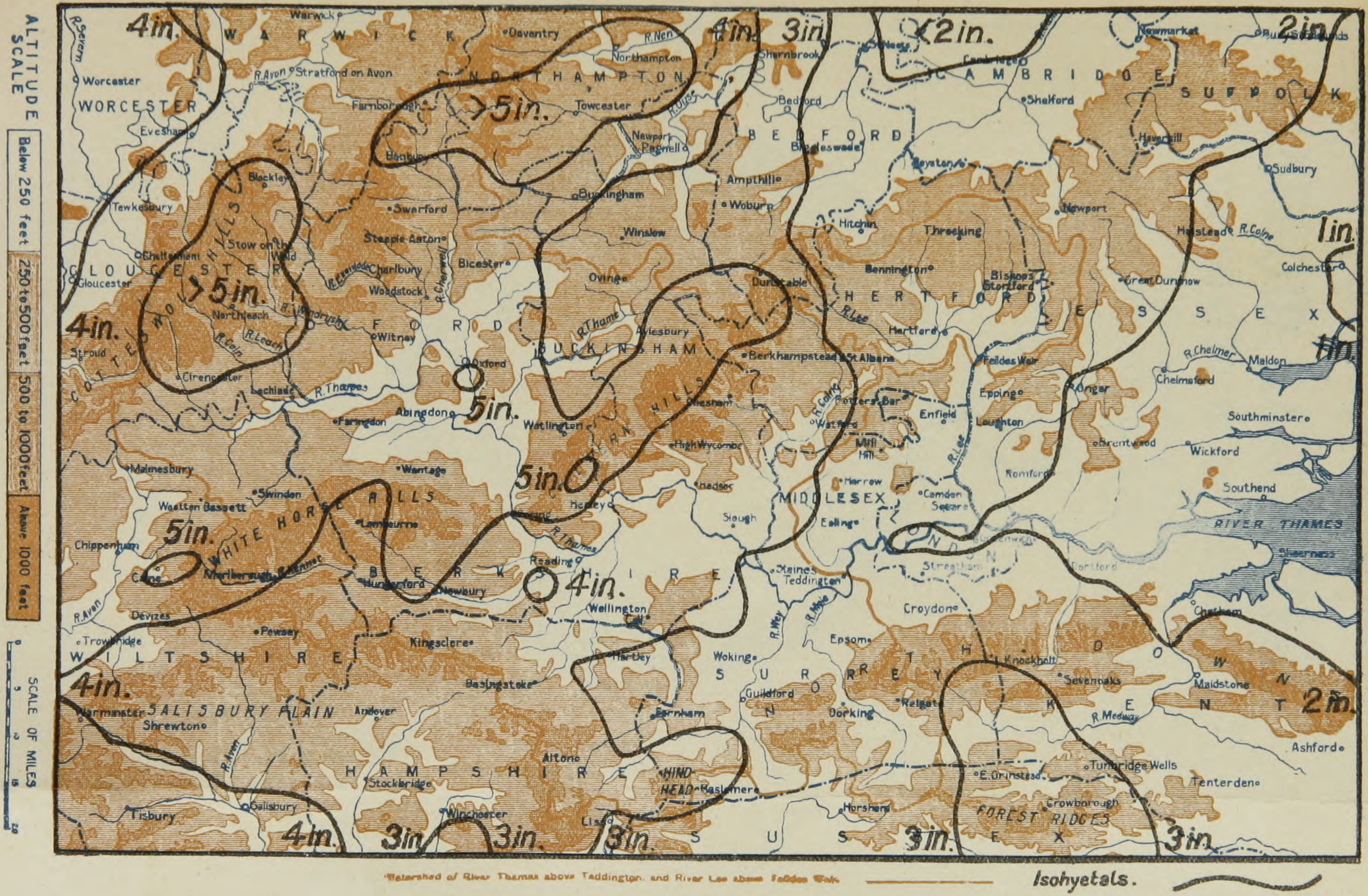
The special message from Brazil states that the rainfalls of the northern and southern regions were respectively 104 mm. and 46 mm. above normal while that of the centre was 34 mm. below normal. Rio Minas and San Paulo States had a long rainless spell. Temperature was generally high and no frosts occurred in the south.

The distribution of total rainfall was determined principally by the great rains of the 6th and 7th. More than 100 mm. (4 in.) rising in places to 150 mm. (6 in.) fell over a broad band between Cornwall and Cumberland, passing through the Midlands. In this area the fall was in many places more than twice the average. Local excesses occurred also in the centre and south of Ireland, but in nearly all other districts the rainfall of the month was slightly deficient; less than 50 mm. (2 in.) was observed in East Anglia and the Fen District, with less than 25 mm. (1 in.) locally in Essex. Less than 50 mm. (2 in.) also occurred in the neighbourhood of the Firth of Forth and the Moray Firth, as well as in parts of Perthshire. The rainy regions of the Western Highlands showed considerably smaller falls than usual, only one or two stations recording as much as 150 mm. (6 in.). Falls of more than 150 mm. (6 in.) were more widespread in the Northern Pennines, but were very local in the uplands of Wales.

The general rainfall expressed as a percentage of the average was: England and Wales, 132; Scotland, 78; Ireland, 104; British Isles, 109.

In London, Camden Square, the mean temperature was 59·1° F., or 3·3° F. below the average, the duration of rainfall 38·4 hours, and the evaporation 1·74 inch.

THAMES VALLEY RAINFALL —— AUGUST, 1922.


ALTITUDE SCALE
Below 250 feet
250 to 500 feet
500 to 1000 feet
Above 1000 feet
SCALE OF MILES
0
5
10
15
20
Watershed of River Thames above Teddington and River Lee above Feildes Weir.
Isohyetals.
4in.
5in.
>5in.
3in.
2in.
1in.
<2in.
WORCESTER
WARWICK
NORTHAMPTON
BEDFORD
CAMBRIDGE
SUFFOLK
GLOUCESTER
OXFORD
BUCKINGHAM
HERTFORD
ESSEX
MIDDLESEX
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CHILTERN HILLS
WHITE HORSE HILLS
SALISBURY PLAIN
NORTH DOWNS
FOREST RIDGES
HIND HEAD
RIVER THAMES
R. Thames
R. Severn
R. Avon
R. Nen
R. Ouse
R. Thame
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R. Medway
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Evesham
Tewkesbury
Cheltenham
Gloucester
Stroud
Cirencester
Northleach
Stow on the Wold
Blockley
Warwick
Stratford on Avon
Farnborough
Banbury
Daventry
Northampton
Towcester
Newport Pagnell
Buckingham
Swerford
Steeple Aston
Charlbury
Woodstock
Bicester
Witney
Oxford
Lechlade
Faringdon
Abingdon
Wantage
Malmesbury
Swindon
Wootton Bassett
Chippenham
Calne
Marlborough
Avebury
Lambourn
Hungerford
Newbury
Devizes
Pewsey
Trowbridge
Warminster
Shrewton
Tisbury
Salisbury
Andover
Stockbridge
Winchester
Kingsclere
Basingstoke
Alton
Liss
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Loughton
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Ongar
Brentwood
Newport
Great Dunmow
Haverhill
Newmarket
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Sudbury
Halstead
Colchester
Chelmsford
Maldon
Southminster
Wickford
Southend
Sheerness
Chatham
Dartford
Greenwich
Streatham
Croydon
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Dorking
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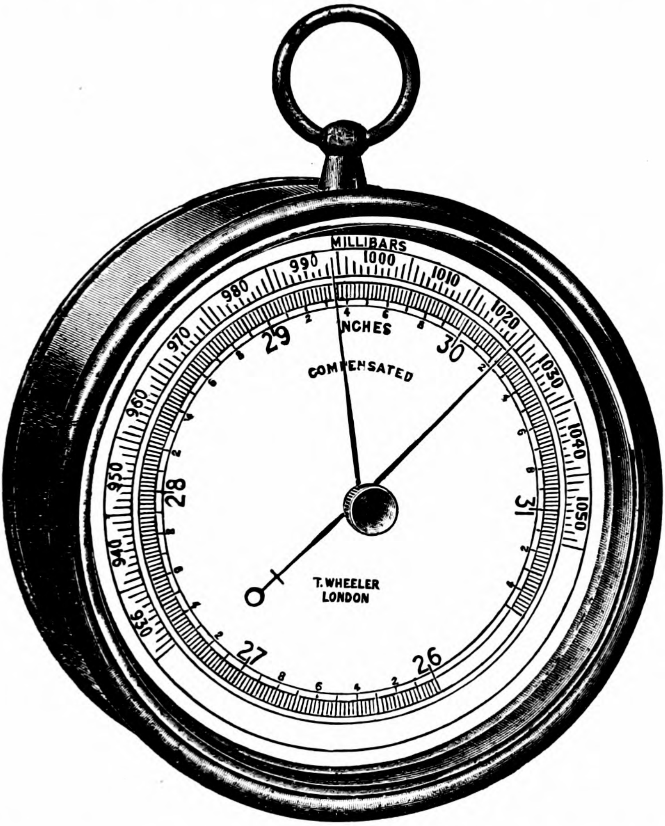
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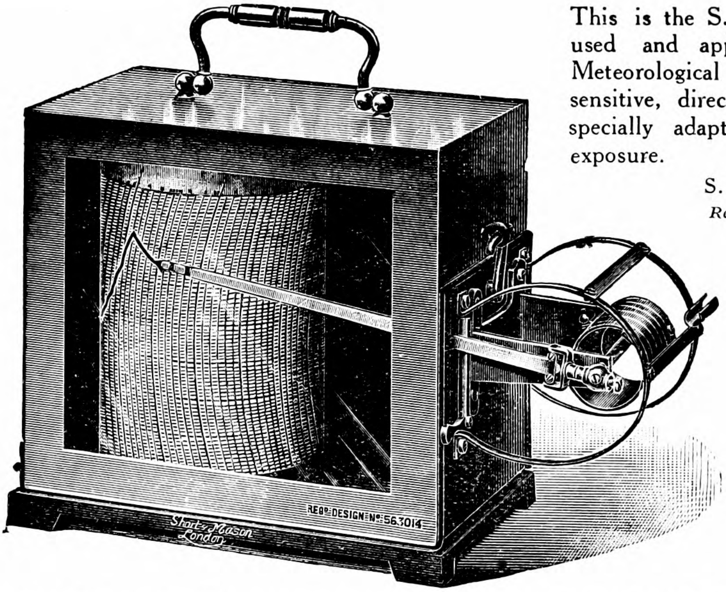

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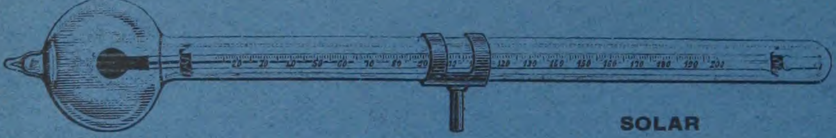

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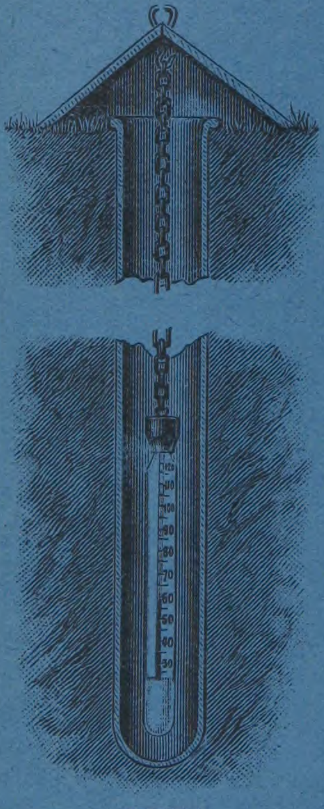

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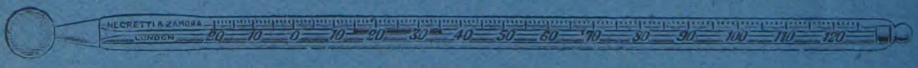

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The responsibility for all facts and opinions expressed in the signed articles and letters published in this Magazine rests with their respective authors.

OCTOBER, 1922.

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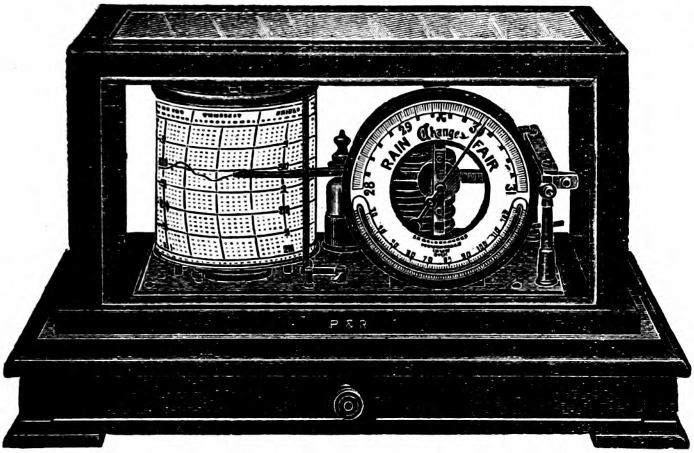

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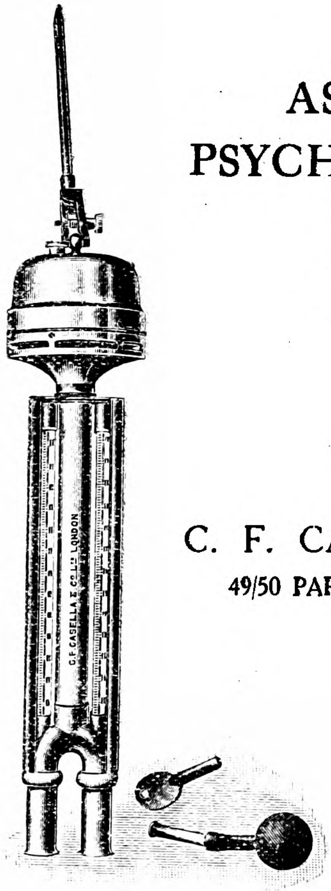
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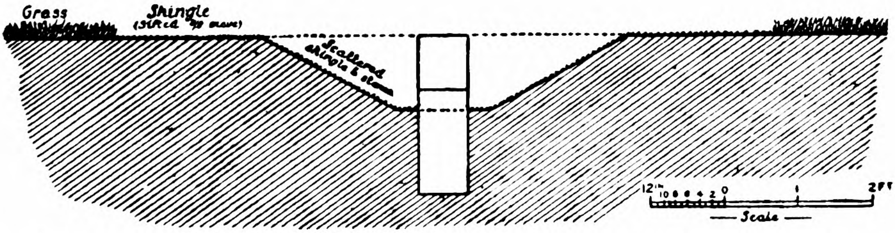
Exposure of Rain-gauges.

BY LT.-COL. E. GOLD, M.A., F.R.S.

THE effect of exposure upon the catch of a rain-gauge is known to be important, but there is little precise information about the magnitude of the effect,* partly owing to the difficulty of securing a proper standard with which to compare the record from a gauge which is unduly exposed to strong wind.

Some ten or twelve years ago I put forward a suggestion for having a rain-gauge placed in the centre of a circular hole, but it was not until the early part of 1922 that an experiment of this character was made, owing to the initiative of Mr. L. H. G. Dines, at Valencia Observatory, where the 8-inch gauge hitherto in use is placed in an open field. A conical hole, about 5 feet in diameter and 1 foot deep, was dug in the same field and a similar rain-gauge was placed in the centre of the hole so that its upper rim was practically on a level with the general surface of the ground. The object of placing the gauge in a hole was to shield the gauge from the strong wind without shielding it



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* Various modifications of gauges have been suggested to avoid the direct effect of high wind; one of these is the Nipher gauge.

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from the rain and at the same time to prevent water running or splashing into the gauge from the surrounding ground. The cross-section of the hole is approximately that shown in the accompanying figure.

The result of the experiment shows that during a period when the ordinary 8-inch rain-gauge caught 335 mm. the gauge in the hole caught 387 mm., an excess of about 15 per cent. The deficiency of the gauge in the ordinary exposure might have been attributed to the effect of the wind, but it was clear from an examination of the rain caught in the gauge in the hole that there had been insplashing in spite of the precautions taken against it. The water caught was very dirty indeed: on one occasion small stones were found in it.

It is clear that the effect of insplashing upon the catch of a gauge placed in a hole, such as that at Valencia, will increase as the wind increases, because the result of an increase of wind will be to reduce the effective distance between the level ground and the gauge. This may account, at any rate in part, for the fact that the difference at Valencia between the two gauges is 15 per cent., whereas in the experiments described in *British Rainfall* 1865, made at Calne in Wiltshire, the difference was only 5 per cent. Partly also the difference is no doubt due to the sloping side of the hole at Valencia: an approximately vertical side would be preferable.

It appears clear that insplashing is more important than had hitherto been supposed and that even with gauges whose rims are one foot above the level of the ground, we cannot be sure that the amount of water splashing into the gauge can be neglected.

If the amount of water per unit time passing downwards across unit area (1 cm.^{2}) of a horizontal plane at a height above the ground sufficient to make certain that no water which has splashed from the surface of the ground reaches it, say 100 metres, is M grams per second, then the amount of water passing downwards across unit area of a horizontal plane near the surface of the ground, will be $M + m$ grams per second, where m is a function of height decreasing upwards: m will depend upon the nature of the surface of the ground, upon the size of the falling drops and upon the wind, and especially upon the turbulence of the wind. In a high wind the relatively fine spray from the splashing drops will undoubtedly be carried upwards to heights of 10, 20 or 30 metres. If we assume the surface of the ground to be uniform over a large area, then the value of m must necessarily be always positive. It is, of course, balanced by an equal rate of transfer *upwards* of the splashing water in the absence of any obstacles to the contrary, so that the *net* transfer downwards across unit area of a horizontal plane is M grams per second everywhere; but it is to be remarked that if we interfere with the upward motion across the horizontal plane and allow only downward motion, as we do with an ordinary rain-gauge, then there is no balance effected and the catch of the gauge will be the integrated value of $M + m$ and not the "true" rainfall, the integrated value of M.*

Two ways of avoiding the effect of m with a view to arriving at an accurate standard suggest themselves, but it will be seen that difficulties and objections can be raised against them. One is to place the gauge at such a height, say 100 metres, as to prevent any risk of the value of m differing appreciably from zero. The other method is to have the gauge itself covered with the same surface as the surrounding country, so that conditions are uniform over the area in which the gauge is situated and the amount of water which splashes into the gauge is exactly balanced by the amount which splashes out. Such uniformity is not easy to attain when, as in this case, it is necessary to ensure that the water falling on to the surface within the circumference of the gauge must be free to run down into the collecting can. It might be approximately achieved by having shingle of uniform size over the area in which the gauge is placed and filling with the shingle a wire tray fitting into the top of the gauge. It might also be achieved by having a fine-mesh wire netting placed horizontally, or supported, at about 1 foot above the ground with the rim of the rain-gauge just touching the wire. The area of the gauge should be large (*i.e.*, at least 100 times) compared with the area of a mesh. It is clear that in a windy region the area over which uniformity is necessary must be considerable in extent, because wind may carry the spray from the splashing rain many tens of yards.

It might appear simpler to attack the problem by putting a rain-gauge on the top of a high mast such as a wireless mast, and arriving at a standard in that way; but here we meet with the difficulty that the wind blowing past the gauge causes an unsymmetrical distribution of eddies, which interfere with the amount of rain caught. The air moving upwards from the windward side of the gauge may not carry up with it the drops of rain, but it may be sufficient, as it moves across the top of the gauge, to carry out the rain drops which it receives in its progress.

This question of the exposure of the rain-gauge is one of practical importance; our knowledge of it is inadequate and it is a question which can be tackled at one place by an amateur meteorologist, especially if he lives in a wet and windy place. I do not suggest that he can obtain a complete solution, but he may, at any rate, contribute to the solution of a problem which appears to have been very nearly neglected during the last 50 years and I therefore commend it to the attention of meteorologists who are seeking for an avenue of useful work in this subject.

---

* It should be noticed, however, that evaporation from the falling rain will act in the opposite direction to m and tend to decrease the quantity crossing a horizontal plane as the level of the plane falls.

As *British Rainfall*, 1865, is not perhaps readily available I give the following extracts relating to the experiments at Calne, which extended up to a height of 20 feet above the ground :—

> ISOLATED SUNK GAUGE.—The rain caught at Calne, in 1864, in a gauge whose mouth was level with the surface of the earth, was about 5 per cent. greater than in that whose mouth was 1 foot above it; it was suggested that it might arise from insplashing, in support of which the frequency with which earth and small gravel are found in gauges so sunk was mentioned. In order to ascertain if this was the whole or partial cause, Colonel Ward has had a gauge sunk in a small pit so that it is level with the ground, but the earth being removed for some distance round it, no insplashing can occur. This has only been at work nine months. The result during that period has been—

	Total in.	Excess above fall at 1 ft.
Gauge at 1 foot above ground -	23·08	0·00
,, 6 inches ,, -	23·24	+ 0·16
,, 2 ,, ,, -	23·61	+ 0·53
,, level with the ground	23·91	+ 0·83
,, isolated and level with the ground - -	23·60	+ 0·52

For the year 1865 the following table shows total amounts collected in a gauge placed at different heights above the ground.

Height above ground.	Calne, Wilts.	Greenwich Observatory.	Manchester.	
			8 in.	5 in.
	in.	in.	in.	in.
Level	32·29	—	—	—
2 inches	31·97	—	—	—
5 ,,	—	28·67	—	—
6 ,,	30·76	—	—	—
1 foot - -	30·43	—	33·71	33·83
2 feet - -	29·81	—	—	—
3 ,, - -	29·88	—	—	—
5 ,, -	29·45	—	32·06	31·48
10 ,, - -	28·91 ?	27·69	—	—
20 ,, -	28·88	—	30·27	29·48
38 ,, - -	—	22·20	—	—
51 ,, - -	—	19·00	—	—

Further experiments are described in *British Rainfall*, 1867 and 1871. At Strathfield Turgiss, near Reading, a gauge on a post at a height of 20 feet recorded about 7 per cent. less than a gauge 4 inches above the ground during the four years 1868–1871. At Rotherham in one year, a gauge, 20 feet above the ground recorded about 10 per cent. less than a gauge 1 foot above ground.

[The percentage decrease in the case of gauges placed on the windward side of a hill slope, compared with gauges on level ground in the neighbourhood, is much greater than the decrease with height: on the lee side the fall is greater than on level ground. This may be a refraction effect: the " rays " of falling raindrops being " refracted " away from the vertical on the windward side and towards the vertical on the lee side.]

I may also add that the late Dr. Buchan wrote a short paper on " a protecting wire screen for the rain-gauge," in the *Journal of the Scottish Meteorological Society*, Volume IV. After discussing the effect of a net in reducing motion of the air, he says :—

> " Suppose then, a shallow pit fully a yard in diameter, made in an open grass plot, and a wire screen with meshes an inch wide laid over it, so that the screen will be exactly on a level with the grass plot. In the centre of this pit place a rain-gauge having its rim about an inch below the wire screen. Since the grass plot and the wire screen are at the same level, and since the wind has no access to objects under the screen, the rain-gauge will thus be protected from eddies of wind or other disturbing currents. By this arrangement the errors in observing the rainfall arising from eddies will be eliminated. The diameter of the pit is proposed to be made large, in order that the insplashing and outsplashing of the rain-drops, as they break on the wires of the screen, may counterbalance each other. The error due to the wetting of the wires, being practically a constant quantity for every time the wires are wetted, may be approximately ascertained and allowed for. It is scarcely necessary to add that the screen itself will require to be kept horizontally over the pit."

Meteorology at the British Association Meeting at Hull.

THE meeting of the British Association at Hull was well attended and the programme contained a number of items of geophysical interest. The meteorological arrangements outlined in the last issue of this Magazine were successfully carried out, thus maintaining the meteorological activity revived at the meeting in Edinburgh last year, after the lapse during the war.

Prior to the meeting, Dr. G. C. Simpson, F.R.S., was elected a vice-president of the Mathematical and Physical Section (Section A). This recognition of the subject will be welcomed by all meteorologists.

Sir Napier Shaw's paper on "Convection in the Atmosphere" was a study of certain atmospheric processes based upon the consideration of meteorological observations in relation to laboratory experiment.

The atmosphere is endowed with a certain stability or vertical resilience in consequence of the normal distribution of potential temperature. Successive layers can slide one over the other, but preserve their separate identity. In relation to the facilities of motion the atmosphere is like a pack of cards.

There are three physical processes which overcome this natural stability and cause the relative displacement of air-masses upwards and downwards in spite of the layering. One of these processes is eddy motion due to frictional or viscous forces. It carries upward the air of the surface (which is normally relatively moist) and may cause cloud or drizzling rain. A second is the well-recognised flow of air across the isobars at the surface. The effect of this flow is, on the one hand, to let down the general mass of air within an anticyclone at the rate, perhaps, of 80 metres per day, and, on the other hand, to pile up air over the area of a cyclone at the rate of about 80 metres per hour. This process used to be regarded as controlled by thermal convection and, therefore, as pointing to the cause of maintenance of low pressure; on the contrary, it should be regarded as the natural method of annihilating cyclones. It would invariably succeed if there were not some means of renewing the energy.

The third process is true thermal convection by which the lower air penetrates the layers above it in virtue of its own levity, aided by the facility for condensing its moisture on cooling. The process is expressed by a column of air pushing upward and expanding as it rises. It may produce sudden and heavy rain.

A rainfall at the rate of 1·5 mm. per hour, giving 1·5 in. per day, is provisionally suggested as the lower limit of convective rainfall; below that the rainfall is eddy rainfall or cumulative rainfall.

The exceptional nature of thermal convection was illustrated by examples of pillar clouds and led to the question of the ultimate nature of the process; whether it was analogous to that of air in water which comes up as a multitude of small bubbles, a fine mixture of the air and the water. Stress was laid on the peculiar importance of this form of vertical motion because of its evictive action. In its rapid ascent it carries along many times its own volume of the air through which it travels and causes dynamical effects not yet fully explored, but certainly important.

In the paper by Dr. J. S. Owens on "Atmospheric Dust," a short description of the jet apparatus for obtaining dust counts from the air was given and the principle upon which the instrument operates described.

The instrument depends for its effectiveness upon the reduction of pressure, and consequent condensation of moisture, brought about in a ribbon-shaped jet of air, which is caused to impinge upon a microscope cover-glass at a very high velocity. The dust particles adhere to the cover-glass by virtue of the condensed water and remain when the water evaporates. The nature of the record obtained is a linear deposit of dust 10 mm. long; 50 cc. of air are used for obtaining a dust count and if it is desired to examine for soluble salts a larger volume, about 1,000 cc., is used, when the salts dissolved from the dust in the condensed water re-crystallise on the cover-glass.

The nature of the dust was discussed and the methods of examination and counting. Reference was also made to records which showed practically no dust but a large number of crystals of common salt.

The practical bearings were considered; a means for examining the quantity and nature of atmospheric dust was shown to be necessary in the study of visibility, for the testing of air-purifying plant, and in connection with a study of the various dust diseases, such as silicosis. There is also a bearing upon the question of fog production by the condensation of water, and upon hygroscopic nuclei.

The sources of dust were next considered and the discovery of spherical transparent particles in the air was described. The number of these spherical particles varied greatly from time to time, but in a record taken on March 16th, 1922, at Westminster, 50 per cent. of the particles were spherical and many colourless and transparent, with a diameter up to 1·5 microns. The possible origin of these spherical particles was discussed and it was found that they were not soluble in water, xylol or oil, and did not stain. They were too small to be micrococci or pollen grains, and it was thought that the most likely source of such particles was volcanic, although they may possibly be of solar or cosmic origin. The question has not yet been definitely settled.

Records of dust found in the atmosphere at different places were mentioned as follows:—

1922.		Particles per cc.
September 2	Holme, Norfolk. Sea coast -	152
,, 5	Brighton	1,380
,, 10 (Sunday)	Hull	3,080
,, 11 (Monday)	Hull	13,800
,, ,,	Hull (seaward of Spurn Head)	140

A fundamental difference between the dust-counter described and Aitken's is that, in the former, dust particles are examined under a high power and water drops are not taken into account, as all water has evaporated from the record before examination. In Aitken's dust-counter the only particles counted are water drops, in each of which a dust nucleus is assumed to be present, although invisible, since a low power objective must be used.

The weather charts and forecasts exhibited daily by the Meteorological Office were again widely appreciated. The reception by wireless of data messages and the subsequent steps in the preparation of the forecasts were witnessed by a very large number of visitors, and much interest was displayed in meteorological work generally. The paper read by Mr. M. A. Giblett before Section A contained a general description of this demonstration, followed by an outline of the present organised use of wireless telegraphy in collecting weather information at the Air Ministry, and in distributing data and forecasts. The facilities thus existing for the daily construction of current weather charts in universities and other educational institutions was pointed out, and emphasis laid on the value of this work, both from the educational point of view and as an aid to the appreciation of forecasts. Reference was made to the development of the New International Code, which embraces the more detailed meteorological information taken into account in modern forecasting, and also to the general lines on which forecasting is progressing, exemplified particularly by the generalisations of the Norwegian school of meteorologists.

Reports were made by the Committees for the Investigation of the Upper Atmosphere, for Seismological Investigations and for assisting work on Tides. The first indicated steps taken towards securing wide co-operation in the study of the upper air, in particular the investigation of the generality of the high correlation coefficients relating to temperature variations in the middle layers of the atmosphere, derived from Mr. W. H. Dines's observations in England. The provision of suitable instructions for observations with pilot-balloons of long-carry, both on land and sea, is also under consideration. The second report, drawn up by Prof. H. H. Turner, was noteworthy for an account of a very recently discovered and well supported earthquake periodicity of slightly over 21 minutes. The third report mentioned that the meteorological effects on tides at Newlyn, Liverpool and other places have been under consideration this year at the Tidal Institute, Liverpool.

Other events included a "Citizens' Lecture" on "The Earth's Magnetism" by the Rev. A. L. Cortie, S.J., and a lecture to Section A, by Prof. J. Proudman, on "Tides, with special reference to the North Sea." The proceedings of the Geology Section included discussions on "Wegener's Hypothesis of Continental Drift," and on the "Geological History of the North Sea Basin" and a paper by Prof. A. P. Coleman on "Pleistocene and Recent Ice Conditions in north-eastern Labrador."

The Cosmical Physics sub-section of Section A joined the Geography section in a discussion on "Monsoons," and also joined the Economics and Agriculture Sections in one on "Weather Cycles in Relation to Agriculture and to Industrial Fluctuations."

The "Meteorological Luncheon" was again held, the seismologists joining the meteorologists as on previous occasions. The party, which numbered 30, assembled at Powolny's restaurant and included Sir Napier and Lady Shaw, the Rt. Hon. Lord Bledisloe (President Agriculture Section), Sir William Beveridge, Dr. G. C. Simpson, Col. H. G. Lyons and Mr. A. P. Lyons, Prof., Mrs. and Miss Turner, Prof. E. W. Brown, Dr. and Mrs. J. S. Owens, Mr. G. G. Chisholm, Mr. and Mrs. J. Downs and Mr. B. W. Downs, Dr. G. W. Grabham, Dr. H. Borns, Dr. Harold Jeffreys, Dr. C. W. B. Normand, Mr. J. J. Shaw, Mr. F. A. Bellamy, Miss E. F. Bellamy, Miss Winchester, Mr. J. E. Clark, Mr. W. G. Mitchell, Capt. W. H. Pick, Mr. M. A. Giblett and Mr. W. Andrews.

M. A. G.

Official Publications.

Geophysical Memoirs No. 19. Hurricanes and Tropical Revolving Storms. By Mrs. E. V. Newnham, M.Sc. With an Introduction on *The Birth and Death of Cyclones.* By Sir Napier Shaw, F.R.S. Pp. viii+122, illus. 1922. Price 12*s.* 6*d.*

THE preparation of this Memoir was the outcome of an inquiry from the Colonial Office as to the incidence of tropical storms in various parts of the world. The scattered literature of the subject has been analysed and arranged in a form convenient for reference. It is hoped that some account of the Memoir will be published later in this Magazine.

Correspondence.

To the Editors, *The Meteorological Magazine.*

The Design of Rain-gauges.

I HAVE read with interest the article on the design of rain-gauges in *The Meteorological Magazine* for July, 1921, and Mr. Halliwell's letter in the following number.

May I suggest that, at any rate in the tropics, item 3 of the "essential features" should be added to, and the existence of an inner collecting vessel of not more than half the diameter of the main gauge be recommended. This will involve in general two receivers, the outer one of which may, on occasion, be the whole body of the gauge, though this is undesirable if the capacity of the smaller one is often exceeded in a single day's rainfall.

The best way I can demonstrate this point is from the results of an experiment here in which I had six 5-inch gauges in a row, roughly north-west to south-east, seven feet apart, the dominant wind being south-west, and all the rims 12 inches above the ground. The gauges were alternately of the standard type, with receivers of diameter 4½ inches, and of the British Association type, with no upper cylinder, and the rim immediately above the oblique face of the funnel, but having inner receivers with a diameter of 2·5 inches and a capacity of 2·3 inches of rainfall.

By the accepted criticisms of the British Association gauge they should have recorded less than the others on account of splash and wind eddies. The difficulty with snow does not arise here, but the intensity of tropical rainfall is proverbial, so that splash certainly had its opportunity. The experimental fact was that the British Association gauges with small receivers recorded more than the others, notably on days of little rainfall, when the odd hundredth or couple of hundredths might be 10 per cent. of the whole. On October the 30th, when there was over 2 inches of rain, the difference was less than 1 per cent.

The point of these experiments was not as between the Snowdon and British Association funnels, but in regard to the containers, and it is clear that either pattern of container can be put under either pattern of funnel.

As far as I can see, it was largely a matter of evaporation. I have found the under side of the funnels of the standard gauges covered with moisture in the morning of days when about ·05 in. of rain had fallen, while those of the British Association gauges were apparently dry. I do not believe that this difference was in any way a function of the funnels, but of the receivers; the little ones not only had a smaller water surface, but had a free air-space between their outer surface and the inner surface of the main gauge. This would account for the agreement on the day of the heavier rain, when the tendency to evaporate was in any case so small that precautions against evaporation were unnecessary. It is probable that the point would be less appreciable in the British Isles, but as there are a good many parts of the Empire that get their meteorological supplies from London, a note may not be out of place.

I may add that in this particular case I do not think wind eddies came into play very much, as a previous experiment on the same site, lasting several years, showed that two British Association gauges, one of which was reinforced by a guard a couple of feet in diameter, showed very little difference (*i.e.*, the guard was superfluous), although a similar pair in another part of the grounds showed more rain in the shielded gauge.

On January 9th, 1922, in order to see how far the rims or the receivers were responsible for the difference in the readings, I exchanged four of the receivers—*i.e.*, the outer covers and rims were not changed, but the small receivers from under gauges Nos. 2 and 4 (British Association rims) were taken out and put under gauges 3 and 5 (standard rims) and conversely. As was anticipated, the effect of the change was to increase the amounts under the standard rims that now had small receivers, and to decrease the amount under the British Association rims that now had large receivers.

The percentage offsets from the reference gauge in each of the periods is shown in the Table below :—

Date and Type of Rain. 1″ per day as Criterion.		8″ Reference Gauge.		Percentage Offset of Experimental Gauges.					
				1 Standard Rim.	2 British Assn. Rim.	3 Standard Rim.	4 British Assn. Rim.	5 Standard Rim.	6 British Assn. Rim.
				Large receiver.	Small receiver.	Large receiver.	Small receiver.	Large receiver.	Small receiver.
		in.	mm.	%	%	%	%	%	%
19.9.21 to 9.1.22	Light	13·17	334·5	− 6·8	− 0·4	− 7·2	− 1·1	− 3·7	+ 0·4
	Heavy	4·48	113·8	− 0·9	+ 0·4	− 1·3	− 0·4	− 0·4	0·0
				Large receiver	Large receiver	Small receiver	Large receiver	Small receiver	Small receiver
10.1.22 to 13.6.22	Light	14·85	377·1	− 5·6	− 5·8	− 3·4	− 4·9	− 1·6	− 3·5
	Heavy	22·28	565·9	− 0·9	− 0·8	0·0	− 0·5	− 0·5	− 0·2

On comparing the effect of the changes, the following results were obtained :—

Gauges.	Change in Receiver.	Mean change in offset percentage.	
		Heavy Rain.	Light Rain.
1 and 6	No change	− 0·1	− 1·3
2 and 4	Small to large	− 0·6	− 4·6
3 and 5	Large to small	+ 0·6	+ 2·9

The change of −1·3 found in the case of the unaltered gauges 1 and 6 must be attributed to errors in observing, to the effect of difference of site (which might be noticeable in the north-east or south-west monsoon), or to difference in humidity, and hence in evaporation. The agreement in the case of the heavy rainfall suggests that the effect is not wholly one of poor observation; it must be largely due, therefore, to a seasonal change in wind and humidity. So that, in order to estimate the changes due to difference in receivers, the values must be corrected for this seasonal variation. For example, in the case of light rain, the offsets −4·6 and +2·9 can be regarded as (−3·7 − 0·9) and (+3·8 − 0·9), where 0·9 is the common seasonal difference comparable to the 1·3 change in the outside gauges 1 and 6.

A further experiment on evaporation was tried on August 9th and 10th. It was purely an artificial test, as the day was rainless and so more conducive to evaporation than a rainy day. At about 9 a.m. on the 9th the six gauges, arranged as before, were filled with water so that in each case the tip of the pipe was below the water-level. It will be seen that water vapour from the bulk of the evaporating surface is prevented from escaping, except through any passage which might have been left between the lower parts of the funnels and the upper parts of the containers. The standard rims fit more closely than the British Association rims. A very small quantity of vapour will escape, also, from the area enclosed by the pipe.

The table below shows the results of the experiment :—

Gauge.	Rim.	Receiver.	Water put in on Aug. 9th.	Water measured on Aug. 10th	Loss.	State of inside of gauge on the morning of August 10th.
			in.	in.	in.	
1	Standard	Large	4·69	4·64	·05	Under side of funnel and vertical walls very wet. Large drops on base outside receiver, which had evidently run down the walls.

Gauge.	Rim.	Receiver.	Water put in on Aug. 9th.	Water measured on Aug. 10th.	Loss.	State of inside of gauge on the morning of August 10th.
2	Brit. Assn.	Large	2·84	2·81	·03	A few drops under funnel, but nothing appreciable on base.
3	Standard	Small	1·95	1·93	·02	Drops on vertical underside of funnel and vertical walls, but not on base.
4	Brit. Assn.	Large	2·91	2·86	·05	Drops on under side of funnel and walls; more than on No. 3, but less than on No. 1.
5	Standard	Small	1·95	1·93	·015	Similar to No. 3.
6	Brit. Assn.	Small	1·38	1·37	·015	No moisture detected on inner surface of funnel or walls.

The large receivers lost in all ·13 in., and the small receivers only 0·5 in. A certain amount of water vapour escaped at the joint; for example, No. 6 lost a little with nothing to show for it in condensed form and the appreciable amount of recondensed water in No. 1 does not explain the total loss of ·05 in. With similar receivers the loss under standard rims is slightly greater than under British Association rims.

The experiment shows, therefore, that (1) loss by evaporation is a function of the receiver; (2) in both types of gauge some water-vapour escapes at the joint; and (3) standard gauges admit of more loss by evaporation than can be compensated for by the more accurate fit of the rim. A. J. BAMFORD.

Colombo Observatory, Ceylon, August, 1922.

[Mr. Bamford rightly lays stress on the fact that the results he has obtained depend not upon the type of funnel but upon the container. We have often pointed out that the funnel defects of the British Association gauge are relatively unimportant if the position of the gauge is sufficiently sheltered from wind eddies, although the risk of outsplash is always present. The small container usually provided with the British Association gauge is probably a mere accident, but it is an accident which happens to give the degree of thermal insulation so necessary in tropical climates. It is, however, a very clumsy method of achieving the immunity from evaporation which Mr. Bamford points out is desirable. An important point is the facility for sinking the lower part of the body of the gauge in the ground, a course which is practically impossible with the short British Association pattern. Evaporation can be practically completely prevented if a glass bottle be placed within the metal receiver to contain the collected water. A further precaution would be the adoption of Casella's insulated rain-gauge (see *Symons's Met. Mag.*, Vol. 45, 1910, p. 182), a pattern admirably suitable for tropical conditions.—Ed. *M.M.*]

Shortage in Shallow-funnel Rain-gauge compared with Snowdon Gauge.

FROM 1906 to 1920 I kept records of rainfall in two types of rain-gauge standing side by side at Asgarth, Purley, at 360 feet above mean sea level on a north-east slope and fully exposed. The results were as follows:—

	Snowdon gauge.	Shallow-funnel gauge.	Percentage Difference.
	in.	in.	
Mean, 15 years -	31·48	31·16	1·0
Most in 1916 - -	39·58	39·15	1·1
Least in 1907 -	25·30	25·10	0·8
Least diffce., 1906 -	30·43	30·37	0·2
Most diffce., 1918 - -	33·66	33·12	1·6
Also, 1919 -	29·29	28·78	1·7

The last gives the highest percentage difference of 1·7 per cent., the mean difference being exactly 1 per cent.

As the station is of fair average character for an open and rather exposed situation these values may be of interest. Snow records were estimated as the same for both.

J. EDMUND CLARK.

41, Downs Court Road, Purley, Surrey, September 3rd, 1922.

Seasonal Variation of East Wind.

MR. BAXENDELL'S information on the monthly frequency of easterly winds at Southport entirely corroborates a table I had already prepared for London using the geostrophic wind-data published in this Magazine during 1920. Comprising under the designation "east" directions from east, north-east and south-east, or leaving out south-east, since not only is the frequency of this direction small but the seasonal variation is also small, I find a very pronounced and protracted season in spring, and a much less conspicuous, shorter season in autumn.

The primary spring maximum of cases of north-east and east winds is prominently embraced by the four months, March, April, May and June, and the secondary autumnal maximum is in September, October and November. As Southport is in the north-west of England, and London in the south-east, this is doubtless typical of the country as a whole.

It appears, therefore, that the proverbial east wind of spring which figures so much in our experience and literature, prevails as regards actual frequency of occurrence in the true spring or equinoctial period, March and April, and in the earlier half of the summer period May and June; but speaking climatologically, it would, perhaps, be truer to say that the real season is limited to March and April, inasmuch as the easterly winds of May and June are much milder both in temperature and strength. Indeed, if the easterly current happens to be reaching us straight from the [illegible]heated Continent it commonly brings warm thundery weather as early as May. Similarly, on the autumnal side of the year, my figures show a higher frequency in September than in November, but the November tendency is more noticeable in common experience because by then the east wind has acquired the sting of winter.

L. C. W. BONACINA.

Hygrometry.

I WAS more than usually interested in the first article of the May issue of *The Meteorological Magazine.* With regard to the use of the dry and wet bulb thermometers for hygrometric purposes, for many years past it has seemed to me that a better plan (for the traveller, at any rate) is to use one thermometer only, and make it report on itself, wet to dry. A good instrument well adapted to be " slung " is readily obtainable; and a wet cap for the bulb can be made sufficiently dense to retain its wetness (not mere dampness) during the few minutes involved.

This last week I have been experimenting with such a device, and comparing results with a " Mason's Hygrometer " in the garden; and I have repeated the operation indoors. As the outdoor instrument is well ventilated, agreement there is quite satisfactory; but indoors the " slung " wet bulb will run two or three degrees lower in temperature than the stationary one. This is in good agreement with the article referred to.

In framing his tables to be used with the wet and dry bulb thermometer, Glaisher seems to have used to some extent Daniell's form of hygrometer. I have employed such a one on occasion for many years past, and often found its behaviour satisfactory. But there were (and are) times when the sought dew-point being very low, atmospheric vapour would attack the muslin of the condensing bulb, and so slow down the action of the sulphuric ether that no result could be got so far as the observation bulb is concerned. In cold weather this defect frequently leads to a display of hoar frost on the muslin. Other observers must be familiar with this defect, but I cannot remember having seen it noted.

WILLIAM GODDEN.

20, Richmond Avenue, Willesden, N.W. 10, June 10th, 1922.

The Green Flash—An Unusual Feature.

On September 20th I observed the "green flash" at sunset from my house at Wadhurst, Sussex, and noted a feature which I have not seen described in previous accounts of the phenomenon.

The sun set over low hills in the Ashdown Forest region and at a distance estimated at eight miles from the point of observation and several isolated rounded trees were projected on the disc for some time before the sun's disappearance. The largest of these trees subtended an angle estimated at about two minutes of arc. The observation was made with a telescope of three inches aperture magnifying eighteen diameters.

The phenomenon occurred in two stages: (*a*) Every tree projected on the disc became suddenly outlined with a narrow hazy border of green light, the rest of the sun retaining its normal colour; (*b*) after a perceptible interval of time the whole of the remaining segment of the sun turned a brilliant clear emerald green and almost simultaneously disappeared below the horizon.

The sky was entirely clear at the time, with a little haze at low altitudes, so that while the setting sun was a golden colour only slightly tinged with red, the light was sufficiently reduced to enable it to be viewed directly without any dazzling or retinal fatigue effects.

E. W. Barlow.

Oct. 5th, 1922.

A Red Rainbow.

At 19h. 40m. on Sunday, July 30th, 1922, from the Western Esplanade, Hove, I observed over the sea about 20° of the southern end of a very remarkable rainbow—a pillar of a dark red brick colour, the red so intense that none of the other prismatic colours could be detected. The western sky at this time was gorgeous in brilliant yellow gold, the sun itself being hidden by a cloud-bank. Gradually the red pillar stretched up and curved over until by 19h. 47m. it reached to a point above the South Downs and about 150° from the sea. The intense redness of the bow was maintained, and continued to swamp other colours, except for a faint indication of green in one or two short spaces immediately above the sea, near which was a faint secondary of about 15°, the same red colour only. Sunset was at 19h. 51m., but the bow, fading away from the northern end, did not vanish until 19h. 56m. The clouds overhead then assumed a soft rose tint, and the sky to west and north-west became a brilliant red. The automatic gauge in the Old Steine, Brighton, registered rain from 19h. to 23h., total ·15 in.; the ordinary gauge, ·11 in.

In my long life I have seen many rainbows, but never before have I beheld a red one—it even imparted a tinge of its redness to the atmosphere! A singular feature deserving of special mention was the appreciably greater breadth of the bow in the section above Brighton, a fact which attracted the attention of others as well as myself. H. HARRIES.

July 31*st*, 1922.

Note added October 4th.—A fortnight later than the above, 15 min. before to 5 min. past sundown, another, but much less complete, bow of the same redness was observed from the King's Esplanade.—H. H.

A Halo in False Cirrus: Interlacing Air-currents.

A SEMI-CIRCUMFERENCE of an exceptionally brilliant halo was in evidence here to-day from 13h. to 13h. 10m. G.M.T.

The sky was practically overcast with low fracto-nimbus (or scud) and strato-cumulus immediately above. Through the gaps could be seen flotillas of alto-cumulus with a thin veil of false cirrus between the strato-cumulus and alto-cumulus. Away to the north showed massive tops of cumulo-nimbus.

The sun gleamed through at about 13h. and an extremely brilliant semicircle could be seen. The outer edge showed gleaming white, changing somewhat abruptly to the dull red-brown of the inside. Measurements hastily made gave a radius of approximately 2°, allowing for the errors due to difficulty in aligning theodolite sights at such a high elevation.

An accompanying point of interest is that the low fracto-nimbus was moving rapidly from south-east, while the strato-cumulus, but very little higher, was drifting more slowly, but quite definitely from north-west by north. The movements were ascertained by nephoscope observation.

The surface wind, during the morning about 10 miles per hour from west-north-west, backed suddenly at 11h. 50m. to south, with little change in velocity.

Rain showers had fallen frequently since 10h.

Aberdeen, August 3rd, 1922. P. F. JARROLD.

[The following information in amplification of Mr. Jarrold's letter has been obtained :—

The striking difference of wind-direction between the surface and the strato-cumulus level persisted for at least three hours. Between 13h. and 15h. the direction from which the low cloud was moving slowly changed to south, whilst that of the strato-cumulus changed to west.

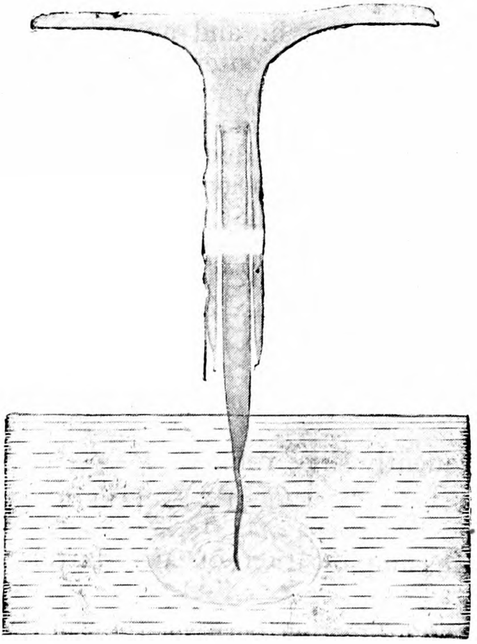
The anemogram from Dyce (6 miles to the north-east of Aberdeen) shows that the light north-westerly wind persisted there until 14h, when it was suddenly displaced by a more vigorous current from the east. On the other hand at 16h. 45m. simultaneous shifts of the wind through a right angle occurred, from south to east at Aberdeen, from south-east to north-east at Dyce.

At Aberdeen the south-easterly current was about the same temperature as the north-westerly one, but considerably damper, with humidity 90 per cent. in place of 80 per cent.—Ed. *M.M.*]

NOTES AND QUERIES.

Some Observations of Waterspouts and Allied Phenomena.

A Waterspout with a " Sheath."



Dr. G. D. Hale Carpenter contributes to *Nature* of September 23rd an interesting account of a waterspout observed on June 30th from the north shore of Bugalla, the largest island in the Sese Archipelago, Victoria Nyanza. The illustration, which is reproduced from *Nature*, shows the unusual structure of the waterspout.

Dr. Carpenter writes: " Surrounding the central core, but separated from it by a clear narrow space, was a sheath, the lower end of which faded away some distance above the water. The profile of this sheath was undulating, it being thicker in some places than others. A curious point is that this sheath seemed to pulsate rhythmically, but I could not say whether the appearance of pulsation might not have been an illusion caused by waves travelling up its outer surface.

"This pulsation gave an uncanny suggestion of a live thing, which was aided by the violent spiral movement upwards in the central core, the clouds of vapour boiling round its base, and the movement of the whole across the water—indeed, we watched it spell-bound until the pedicle dissolved away at the bottom, and the ascent of the part above brought the phenomenon to an end . . . I cannot estimate the height to which the column rose. Its cessation was followed by violent rain and thunder."

Two Cloud Pendants.

A description of two cloud pendants is contributed by Major W. C. Ball, D.Sc., F.I.C. They were observed by him from Clovelly Harbour at about 10 a.m. on September 1st, 1922.

Both pendants were in the form of inverted cones, which depended from the well-defined and dense black under-surface of a cloud. In the case of one pendant, the cone continued in the form of a long tail similar to the lash of a whip. This tail extended about two-thirds of the way down to the sea and was bent into a curve, so that at its lower end it was almost horizontal. The edges of the tail were quite sharp and well-defined. Major Ball thinks that the tail pointed approximately into the direction *towards* which the wind was blowing. Below the lower end of the tail another portion was seen rising from the sea. "The part rising from the water was less distinct than the tail, which was very sharply defined; it appeared later and had a curious filmy appearance. I don't think it was directly below the end of the tail, but I am not certain. I judged that the spout might be about two miles from the shore, and that the part rising from the water was certainly higher than the mast of a fishing boat."

The phenomenon remained visible for about ten minutes and was lost to sight by being carried behind the headland towards Bideford.

Major Ball describes the weather at the time as squally with showers, and the wind as light or moderate.

Captain D. Brunt's remark on waterspouts, written in amplification of Dr. Hale Carpenter's letter and published in the same issue of *Nature* is *à propos*:—

"The thickness of the visible column or zone of condensation therefore diminishes downward, giving the form of an inverted cone of irregular shape. Near the water the air is again near saturation, and the difference between air temperature and dew-point is small, so that the base of the whirl is widened.

It frequently happens that the portion at middle heights is not visible, on account of the relative dryness of the air."

A Waterspout with Fireballs.

The Times of September 5th, 1922, contains a letter from the Reverend G. D'Arcy Blackman, of Wymondham, Norfolk, in which he describes a curious waterspout and asks for some explanation of the phenomenon. He writes :—" A small waterspout was noticed over Norfolk on Friday evening (September 1st) at 6.30 p.m., which, as far as I understand the phenomena, was remarkable by not ending in a heavy downpour of rain, but by releasing two small fire-balls. At any rate, two small fiery substances fell to the ground . . . The waterspout ended in taking the shape of a foot and then gradually dissolved. Most of the village folk—some of seventy years of age—said that the sight was something that they had never seen or heard of."

A Curious Cloud-Pendant.

A curious cloud-pendant was observed by Mr. H. W. Clarke at Killowen at mid-day on August 11th, 1922. The outlines of the pendant were remarkably distinct, the edges appearing as straight as if ruled. The pendant was bent sharply near its extremity, seeming to disappear behind the Knockshee Mountains, towards which the observer was looking. The diameter of the pendant is described as about half the apparent diameter of the sun. The phenomenon was witnessed by many people.

The Audibility of Explosions.

THE International Commission for the Investigation of the Upper Air appointed in 1921 a sub-commission to investigate the transmission of sound of an explosion. Various war ministries were asked to collaborate in the research by arranging for experimental explosions. The Dutch Ministry of War agreed to explode a large quantity of ammonia at Oldebrack on the first day after September 23rd suitable as regarded meteorological conditions. The Air Ministry issued a notice to the press asking for observations of the sound and giving instructions for such observations, which were to be forwarded to the Director of the Meteorological Office. Subsequently, however, it has been reported that people living near Oldebrack have objected to the scheme on the ground that it might cause damage in the town.

It is to be hoped that some way out of the difficulty will be found. Perhaps the best place for a great explosion would be the middle of the North Sea. It should be emphasised that the principal requirement on the meteorological side is a complete set of upper air observations, giving air temperature and wind velocity over a large area. Clear skies are to be desired so that observations of pilot balloons up to great heights may be secured. Under such conditions reliable computations of the trajectories of the sound waves should be possible.

Exceptional Visibility as a Sign of Coming Rain.

In view of the widely-held belief that exceptional visibility is a sign of coming rain, the observations taken at the Meteorological Office, Cranwell, during the 518 days from April 1st, 1920, to August 31st, 1921, have been examined by Mr. W. H. Pick.

Visibility is observed hourly at Cranwell; in the following classification a day with " visibility of 21 miles or more " is a day on which such visibility was observed at one or more of the hours from 9 h. to 17 h., and similarly with a visibility of 13 miles. The days with " visibility of 13 miles or more " include also those with 21 miles or more. " Rain before 7 h." refers to appreciable rain (0·2 mm. or more) during the period between the observation of visibility and 7 h. on the following morning.

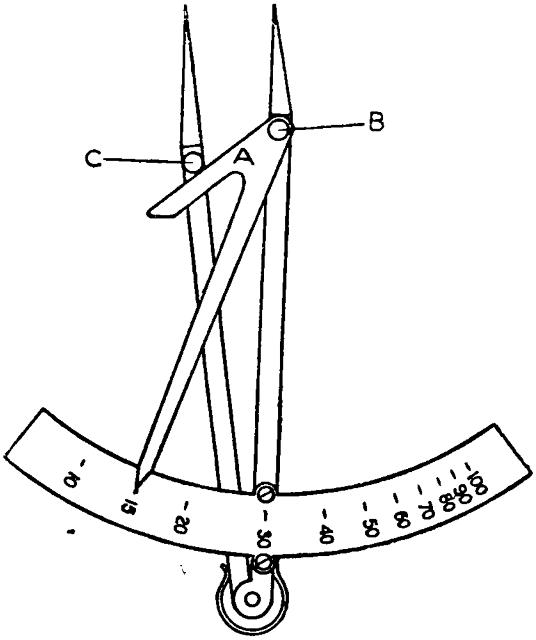
	Days with visibility of 21 miles or more.	Days with visibility of 13 miles or more.	Other Days.	All Days.
Total Days	43	216	302	518
Days with rain before 7 h.	14	83	150	233
Percentage -	33	38	50	45

It will be seen from the table that, so far as Cranwell is concerned, there is no evidence that a day of exceptional visibility is more likely to be followed by rain than a day of low visibility, but rather the reverse. Only one-third of the days on which visibility reached 2 miles were followed by rain; while, in the case of days on which visibility did not reach 13 miles, the proportion is one-half. It should be noted, however, that during a large part of the period examined the conditions were abnormal, both as regards rainfall and clearness of the atmosphere.

Geostrophic Dividers.

THE instrument shown in the accompanying illustration was designed and made at Benson Observatory by Mr. H. W. Baker, for determining the velocity of the geostrophic wind* directly from a synoptic chart.

The velocity in question is determined by the well-known formula $\gamma = 2\omega v \rho \sin \phi$, where γ is the pressure gradient, ω the angular rotation of the earth, v the geostrophic velocity, ρ the density of the air, and ϕ the latitude.


B
C
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80
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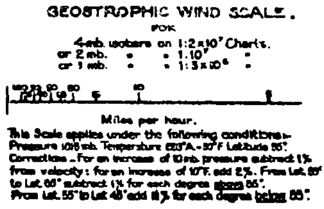
100

Hitherto the velocities have been determined by the use of a scale such as is illustrated below. Such a scale can be made for any chart by using the formula quoted, the actual scale lengths being determined by the size of the chart used.


GEOSTROPHIC WIND SCALE.
FOR
4 mb. isobars on 1:2×10⁷ Charts.
or 2 mb. " " 1:10⁷ "
or 1 mb. " " 1:5×10⁶ "
Miles per hour.
This Scale applies under the following conditions:-
Pressure 1016 mb. Temperature 283°A.-50°F Latitude 55°.
Corrections.-For an increase of 10 mb. pressure subtract 1%
from velocity: for an increase of 10°F. add 2%. From Lat. 55°
to Lat. 60° subtract 1% for each degree above 55°.
From Lat. 55° to Lat. 45° add 1% for each degree below 55°.

The tables printed in *The Computer's Handbook*, Section 2, pp. 71–74, which give distances apart in nautical miles of consecutive 10 millibar isobars corresponding with various geostrophic velocities, are based on this formula and are capable of adjustment to any sized map.

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* A short explanation of the significance of the geostrophic wind is given in this Magazine, February, 1920, p. 8.

It will be seen that in this scale the graduations corresponding with strong winds are inevitably crowded together, so that interpolations are impracticable. Mr. Baker's aim has been to get a much more uniform graduation.

His instrument consists of a pair of legs hinged together; attached to one of the legs is a straight-edged cam (A), which can turn on the bearings (B) and make a sliding contact with the stud (C) on the other leg. Pressure on the stud is maintained by a spring. Fixed to the cam is an arm which serves as an indicator and as a lever for adjusting the divider-points on the isobars. When set, this lever retains its position on the scale by friction.

The scale is graduated from 10 to 100 miles per hour by divisions corresponding to each 10, and, although the graduation is not uniform, velocities may easily be read to within a mile or two per hour* on any part of the scale.

With the exception of the scale the instrument is made throughout of steel, all bearings and sliding surfaces being hardened to prevent wear.

The particular instrument illustrated was designed for use in latitude 55° with 4 mb. isobars on a chart to the scale $1 : 2 \times 10^7$, at a pressure of 1,015 mb. and temperature 50° F.

Meteorological Office Standard Wind-Vane.

In *The Meteorological Magazine* for April, 1921, a description was given of a new type of vane which is now used for pressure tube anemometers with direction recorders. In this type the fin of the vane is a considerable distance from the axis, so that a counterweight of an appreciable size has to be fitted to the forward end near the opening of the pressure pipe in order to ensure that the vane is balanced about its pivot.

It having been suspected that this counterweight might produce an effect upon the air pressure in the pressure pipe itself, arrangements were made with the National Physical Laboratory for a test of one of the vanes in a wind channel. The Laboratory reports that, on comparison with their standard total-pressure tube, the new type of vane was found to give readings correct within limits of ½ per cent. It thus appears that the presence of the counter-weight has no appreciable effect.

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* It is not to be supposed, however, that this order of accuracy has any physical significance.—Ed. *M.M.*

Radiation from the Sky.

RADIATION MEASURED AT BENSON, OXON, 1922.

Unit : one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays).

Averages for Readings about time of Sunset.

		July.	August.	Sept.
Cloudless days :—				
Number of readings	n	6	6	8
Radiation from sky in zenith	πI	541	517	509
Total radiation from sky	J	576	544	554
Total radiation from horizontal black surface on earth.	X	756	720	750
Net radiation from earth	X–J	180	176	196

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

		July.	August.	Sept.
Cloudless days :—				
Number of readings	n_0	0	2	4
Radiation from sky in zenith	πI_0	?	28	28
Total radiation from sky	J_0	?	31	48
Cloudy days :—				
Number of readings	n_1	5	5	4
Radiation from sky in zenith	πI_1	155	145	152
Total radiation from sky	J_1	125	116	131

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

Meteorology and Civil Aviation in India.

THE *Half-Yearly Report on Civil Aviation in India* for January to June, 1922, contains, in addition to flying news, a table of cloud and upper-air observations on the Calcutta-Rangoon route during the month of June. Heavy monsoon weather prevailed over this district; but, in spite of this fact, flying was possible on most days. It is interesting to notice that, in connection with civil aviation, upper-air observations are being carried out systematically in various parts of the country.

The Sound of Aurora.

THE observer at Deerness, in the Orkneys, reports : " On the evening of the 20th and morning of the 21st [of September, 1922] there was the kind of aurora which spreads in clouds of light, and when very brilliant may be heard to give a little sound like the sound made when sifting meal in skin sieves. I have only heard the sound three or four times."

The sound of aurora is a subject open to much discussion, since some travellers in high latitudes record noises of varying intensity, from the " rustling of silk " to the sound of a " squall of wind in the upper rigging of a ship " ; while others report that, though the aurora appeared very near, no sound was to be heard. It is certainly an unusual phenomenon.

Obituary.

VICTOR HERBERT GATTY.—Mr. V. H. Gatty, whose death from heart failure whilst shooting on the moors occurred on August 12th, was an enthusiastic amateur meteorologist, and had been for many years a rainfall observer and occasional contributor to this and other scientific journals. We have received the following personal appreciation from his friend, the Rev. R. P. Dansey :—

" It was a fortunate inspiration which induced the writer to pen an article descriptive of the Glacial Snow of Ben Nevis for this Magazine (Vol. 40, March, 1905). When inspecting the snow beds in July, 1905, I met Mr. Gatty doing the same thing, having seen the article in question. Thus started a warm friendship of seventeen years. Mr. Gatty was keenly interested in British snow-beds and moraines, and in the *Geographical Journal,* Vol. XXVII., May, 1906, there appeared under his name an illustrated article entitled 'The Glacial Aspect of Ben Nevis.' He was a fellow of the Royal Geographical Society and a member of the Alpine, and Fell and Rock Climbing Clubs. He loved the peaceful solitude of the hills and as his guest I climbed with him in the Tyrol, the Graian Alps, the Pyrenees, Norway and Corsica. Two of these expeditions provided material for articles on the Pyrenees and Corsica in these pages, while an article on 'A Long Day on the Justedalsbræ' in Norway appeared under his name in No. 3, Vol. 2, of the *Fell and Rock Climbing Club Journal.* Never a robust man, his varied activities during the war caused overstrain, and he was never equal to serious walking or climbing afterwards. He once expressed a wish to die on a glacier, when his time should come ; but, failing this, he could hardly have wished anything better than to pass away amid the peaceful heather-covered solitudes of a Scottish grouse-moor.—R. P. DANSEY."

News in Brief.

In view of the present interest in " gliding " or " air sailing," the *Daily Mail* has announced a Gliding Competition for a prize of £1,000. The contest, which is to be conducted by the Royal Aero Club, will take place on October 16th to 21st. Should gliding become a popular sport, it promises to yield developments of importance in technical aeronautics, and as its successful practice depends on a knowledge of vertical air currents, stimulus should be given to meteorological research, more especially on the physical structure of the lower atmosphere.

The observer at Ross-on-Wye reports that, at 17 h. on September 6th a dense overhead fog of a greenish tint overshadowed the town, causing such intense gloom that artificial light was necessary. A little rain fell towards 17 h. 30 m., and continued until after 18 h., but the shower was quite local. Outside the town no rain occurred.

Erratum.

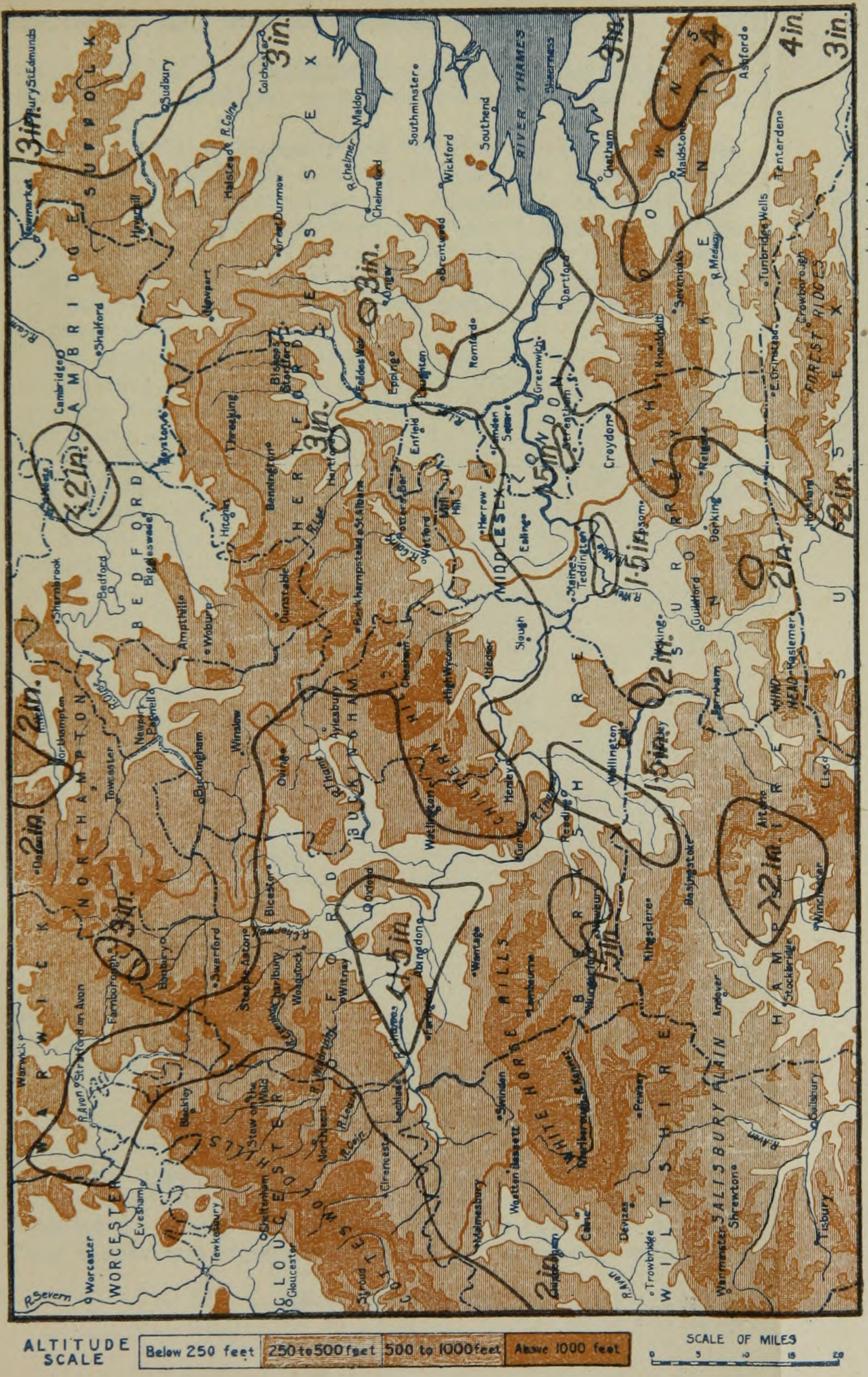
September, 1922, page 214, paragraph 5, line 4, *for* " Ireland " *read* " Iceland."

The Weather of September, 1922.

THE widespread belief that a fine September follows a bad summer has found little justification in 1922. A fair week beginning on the 3rd and a few days about the 23rd were the only settled periods during the month. Mostly the month was unsettled, wet and cold. Rainfall was not generally in excess of the average, but sunshine amounted in most places only to about two-thirds of the average.

On the 1st a low pressure area with several centres extended from Spitzbergen over the British Isles to the Bay of Biscay, while there were anticyclones over Scandinavia and the Azores. Unsettled weather resulted generally, except in Scandinavia, with heavy rain and thunder locally. A thunderstorm at Blackpool on the 2nd gave 78 mm. of rain and caused considerable damage. On the 3rd and 4th the Scandinavian anticyclone extended in a south-westerly direction, with generally quiet but dull weather. A large anticyclonic system was thus established, extending from the Azores to Scandinavia, which persisted for several days, giving a period of quiet weather with night fogs and fairly warm days. By the 8th pressure at the Scandinavian end of the " ridge " had decreased, but at the Azores end it had increased and the area affected had extended north to include Iceland. This northward extension began to recede on the 9th before a depression to the north of Iceland which caused gales and rain, and by the morning of the 11th the anticyclone

THAMES VALLEY RAINFALL ——— SEPTEMBER, 1922.


3in.
2in.
1·5in.
2·21in.
4in.
RIVER THAMES
Sheerness
Southend
Chelmsford
Maldon
Colchester
Sudbury
Newmarket
Cambridge
Bedford
Northampton
Banbury
Oxford
Abingdon
Witney
Wantage
Newbury
Reading
Henley
Wallingford
Aylesbury
High Wycombe
Slough
Ealing
Harrow
Enfield
Hertford
St Albans
Watford
Epsom
Croydon
Greenwich
Dartford
Chatham
Maidstone
Ashford
Tonbridge
Tunbridge Wells
Sevenoaks
Reigate
Dorking
Guildford
Woking
Farnham
Haslemere
Basingstoke
Winchester
Andover
Salisbury
Swindon
Cirencester
Stroud
Gloucester
Cheltenham
Tewkesbury
Evesham
Worcester
Warwick
Stratford on Avon
Devizes
Trowbridge
Warminster
CHILTERN HILLS
WHITE HORSE HILLS
SALISBURY PLAIN
FOREST RIDGES
COTSWOLD HILLS
N. DOWNS
HIND HEAD
LONDON
MIDDLESEX
HERTFORD
ESSEX
SUFFOLK
CAMBRIDGE
BEDFORD
NORTHAMPTON
WARWICK
WORCESTER
GLOUCESTER
OXFORD
BUCKINGHAM
BERKSHIRE
WILTSHIRE
HAMPSHIRE
SURREY
KENT
SUSSEX
R. Severn
R. Avon
R. Kennet
R. Medway
R. Chelmer
R. Colne
R. Lee
Isohyetals.
ALTITUDE SCALE
Below 250 feet
250 to 500 feet
500 to 1000 feet
Above 1000 feet
SCALE OF MILES
0
5
10
15
20

*Watershed of River Thames above Teddington and River Lee above Feildes Weir.

H.M. Stationery Office Press, Kingsway, W.C.2.

PS. 1677/606. Wt.69. D.P.I. 1000. 10/22.

was established in its more usual position over the Azores, with the whole of Scotland under the influence of the Icelandic depression.

On the 12th, a depression, off the Hebrides in the morning, moved south-eastwards over the British Isles, causing general rainfall and gales in the Channel. Acquiring a northerly component on the 13th this depression moved slowly across the North Sea on the 13th, 14th and 15th with strong cold northerly winds and cloudy showery weather, with local thunder behind it. Some of the higher peaks in Scotland received a light dusting of snow on these days.

The appearance of another depression off the Hebrides on the morning of the 16th brought three distinct cyclonic systems into our area, the one which had crossed England being over the Baltic and a third within the Arctic Circle south of Spitzbergen. In all northern areas rainy weather resulted, but southern England and Central Europe enjoyed a fair day. The eastward movement of this complex system on the 17th and 18th brought a showery type of weather to the British Isles and gales in Scandinavia. A depression north of Scotland moving rapidly to the east gave much rain and wind on Tuesday the 19th and improving colder weather on the Wednesday. A "high" following this gave a few days of generally pleasant settled weather.

On the morning of the 25th a very deep depression was situated off the west of Ireland. At 7h. G.M.T. the *Aquitania*, near the centre of the depression, reported a pressure of 952 mb. (28·11 in.); at 13h. the same day she reported a wind of hurricane strength (force 12; Beaufort scale). Fortunately this depression filled up as it drifted slowly eastwards; it finally disappeared over France on the 28th. Although gales were caused on parts of the coast, they were not of excessive violence.

R. A. W.

A message from Rome dated the 8th stated that the Apulian city of Lecce had been swept by a violent storm, which unroofed 600 houses and seriously damaged many churches. On the early morning of the 28th the fort on Monte Falconara, about 8 miles from Spezia (Liguria), was blown up during a heavy thunderstorm. As the fort contained 1,500 tons of explosives, widespread destruction resulted. The adjacent village of San Terenzio was almost entirely destroyed, with considerable loss of life, and the effects of the explosion were felt as far as Spezia.

It was reported from Ponta Delgada on the 4th that the *Quest*, which arrived on that date, had been driven west and delayed by strong north-westerly winds in the North Atlantic. The month was noteworthy for violent storms in this ocean.

(*Continued on p.* 262.)

Rainfall Table for September 1922.

STATION.	COUNTY.	Aver. 1881—1915.	1922.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days.
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	1·82	2·13	54	117	·39	14	14
Tenterden (View Tower)	*Kent*	2·14	2·93	74	137	·53	23	15
Arundel (Patching Farm)	*Sussex*	2·40	2·10	53	88	·65	12	13
Fordingbridge (Oaklands)	*Hampshire*	2·15	1·72	44	80	·72	12	17
Oxford (Magdalen College)	*Oxfordshire*	1·68	1·26	32	75	·28	14	12
Wellingborough (Swanspool)	*Northampton*	1·80	2·09	53	116	·56	14	11
Hawkedon Rectory	*Suffolk*	1·93	3·12	79	162	·80	30	16
Norwich (Eaton)	*Norfolk*	2·14	2·62	67	122	·63	14	17
Launceston (Polapit Tamar)	*Devon*	2·80	3·88	99	139	1·81	12	15
Sidmouth (Sidmount)	"	2·30	2·55	65	111	·66	12	12
Ross (County Observatory)	*Herefordshire*	2·02	1·68	43	83	·44	12	14
Church Stretton (Wolstaston)	*Shropshire*	2·03	2·13	54	105	·45	12	15
Boston (Black Sluice)	*Lincoln*	1·76	2·32	59	132	·73	14	13
Worksop (Hodsock Priory)	*Nottingham*	1·52	2·32	59	153	·62	27	13
Mickleover (Clyde House)	*Derbyshire*	1·79	1·80	46	100	·34	27	13
Southport (Hesketh Park)	*Lancashire*	2·75	2·92	74	106	·62	12	16
Wetherby (Ribston Hall)	*York, W. R.*	1·80	3·02	77	168	·60	13	9
Hull (Pearson Park)	" *E. R.*	1·72	2·08	53	121	·71	14	17
Newcastle (Town Moor)	*North'land*	2·04	4·34	110	213	1·00	13	21
Borrowdale (Seathwaite)	*Cumberland*	9·92	9·00	229	91	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	3·10	3·83	97	124	1·05	12	16
Haverfordwest (Gram. Sch.)	*Pembroke*	3·55	6·03	153	170	1·37	12	16
Aberystwyth (Gogerddan)	*Cardigan*	3·64	5·07	129	139	1·87	18	7
Llandudno	*Carnarvon*	2·28	2·10	53	92	·38	18	16
Dumfries (Cargen)	*Kirkcudbrt.*	2·94	2·90	74	99	·60	12	20
Marchmont House	*Berwick*	2·41	3·41	87	141	·58	28	17
Girvan (Pinmore)	*Ayr*	3·83	2·62	67	68	·45	12	22
Glasgow (Queen's Park)	*Renfrew*	2·77	1·58	40	57	·22	16	19
Islay (Eallabus)	*Argyll*	4·18	3·72	95	89	·97	16	22
Mull (Quinish)	"	4·79	3·38	86	71	·71	16	19
Loch Dhu	*Perth*	5·73	4·30	109	75	1·15	12	13
Dundee (Eastern Necropolis)	*Forfar*	2·08	2·33	59	112	·53	26	19
Braemar (Bank)	*Aberdeen*	2·51	1·95	49	78	·74	26	10
Aberdeen (Cranford)	"	2·34	3·47	88	148	1·25	26	19
Gordon Castle	*Moray*	3·50	2·60	66	104	·77	28	16
Fort William (Atholl Bank)	*Inverness*	6·32	3·54	90	56	·96	16	22
Alness (Ardross Castle)	*Ross*	2·92	1·98	50	68	·25	26,30	15
Loch Torridon (Bendamph)	"	6·95	3·84	97	55	·76	16	20
Stornoway	"	3·95	2·76	70	70	·58	16	22
Loch More (Achfary)	*Sutherland*	5·75	4·81	122	84	1·05	16	21
Wick	*Caithness*	2·50	2·81	71	112	·94	28	19
Glanmire (Lota Lodge)	*Cork*	2·80	3·83	97	137	1·07	26	15
Killarney (District Asylum)	*Kerry*	3·58	..	..	..	..	..	..
Waterford (Brook Lodge)	*Waterford*	2·77	2·53	64	91	·46	26	16
Nenagh (Castle Lough)	*Tipperary*	2·81	3·42	87	122	1·43	18	21
Foynes	*Limerick*	2·79	3·91	99	140	1·37	18	21
Gorey (Courtown House)	*Wexford*	2·47	3·11	79	126	·90	18	11
Abbey Leix (Blandsfort)	*Queen's Co.*	2·72	3·42	87	126	1·05	18	17
Dublin (FitzWilliam Square)	*Dublin*	1·92	2·58	65	134	·46	18	18
Mullingar (Belvedere)	*Westmeath*	2·67	2·61	66	98	1·13	18	14
Crossmolina (Enniscoe)	*Mayo*	3·92	..	..	..	..	..	..
Collooney (Markree Obsy.)	*Sligo*	3·35	3·97	101	119	·72	18	23
Seaforde	*Down*	2·75	3·05	77	111	·61	26	16
Ballymena (Harryville)	*Antrim*	3·11	3·28	83	105	·63	20	22
Omagh (Edenfel)	*Tyrone*	3·05	3·80	97	125	·85	20	20
Letterkenny Asylum	*Donegal*	3·40	2·99	76	88	·53	20	20

Supplementary Rainfall, September 1922.

Div.	STATION.	RAIN.	
		in.	mm.
II.	Ramsgate	3·71	94
"	Sevenoaks, Speldhurst	2·51	64
"	Hailsham Vicarage	3·97	101
"	Totland Bay, Aston Ho.	1·29	33
"	Ashley, Old Manor Ho.	1·75	44
"	Grayshott	1·77	45
"	Ufton Nervet	1·67	42
III.	Harrow Weald, Hill Ho.	2·17	55
"	Pitsford, Sedgebrook	1·85	47
"	Chatteris, The Priory	..	..
IV.	Elsenham, Gaunts End	2·83	72
"	Lexden, Hill House	2·87	73
"	Aylsham, Rippon Hall	3·30	84
"	Swaffham	3·30	84
V.	Devizes, Highclere	1·85	47
"	Weymouth	1·55	39
"	Ashburton, Druid Ho.	3·81	97
"	Cullompton	3·35	85
"	Hartland Abbey	2·67	68
"	Penzance, Morrab Gden.	3·97	101
"	St. Austell, Trevarna	3·39	86
"	Crewkerne Merefield Ho	2·37	60
VI.	Clifton College	2·37	60
"	Ledbury, Underdown	2·02	51
"	Shifnal, Hatton Grange	2·61	66
"	Ashbourne, Mayfield	2·91	74
"	Barnt Green, Upwood	2·55	65
"	Blockley, Upton Wold	2·57	65
VII.	Leicester, Town Hall Sq.	2·10	53
"	Grantham, Saltersford	1·43	36
"	Louth, Westgate	2·75	70
"	Mansfield, West Bank	2·62	67
VIII.	Nantwich, Dorfold Hall	2·93	74
"	Bolton, Queen's Park	4·81	122
"	Lancaster, Strathspey	4·20	107
IX.	Wath-upon-Dearne	2·02	51
"	Bradford, Lister Park	3·22	82
"	West Witton	5·09	129
"	Scarborough, Scalby	3·15	80
"	Middlesbro', Albert Pk.	2·63	67
"	Mickleton	..	..
X.	Bellingham	4·55	116
"	Ilderton, Lilburn	3·70	94
"	Orton	4·31	109
XI.	Llanfrechfa Grange	..	..
"	Treherbert, Tyn-y-waun	7·07	180
"	Carmarthen Friary	4·54	115
"	Lampeter, Falcondale	4·30	109
"	Cray Station	3·90	99
"	B'ham W.W., Tyrmyndd	4·22	107
"	Lake Vyrnwy	4·33	110
"	Llangynhafal, P. Drâw	2·55	65
"	Oakley Quarries	7·99	203
"	Dolgelly, Bryntirion	7·56	192
"	Snowdon, Llydaw 10.	14·50	368
"	Lligwy	3·12	79
XII.	Stoneykirk, Ardwell Ho	3·24	82
"	Carsphairn, Shiel	4·04	103
XII.	Langholm, Drove Rd.	2·95	75
XIII.	Ettrick Manse	2·71	69
"	North Berwick Res.	2·18	55
"	Edinburgh, Royal Ob.	1·72	44
XIV.	Biggar	1·78	45
"	Leadhills	3·84	97
"	Kilmarnock, Agric. Coll.	1·87	47
XV.	Dougarie Lodge	3·04	77
"	Oban	2·53	64
"	Holy Loch, Ardnadam	4·23	107
"	Tiree, Cornaigmore	..	..
XVI.	Loch Venachar	3·15	80
"	Glenquey Reservoir	3·20	81
"	Loch Rannoch, Dall	2·24	57
"	Blair Castle Gardens	1·70	43
"	Coupar Angus	1·78	45
"	Montrose Asylum	2·89	73
XVII.	Logie Coldstone, School	2·47	63
"	Fyvie Castle	2·41	61
"	Grantown-on-Spey	1·84	47
XVIII.	Kingussie, Fasnakyle	1·17	30
"	Fort Augustus	1·57	40
"	Loch Quoich, Loan	9·10	231
"	Fortrose	1·42	36
"	Faire-na-Squir	..	..
"	Skye, Dunvegan	3·34	85
XIX.	Loch Carron, Plockton	2·05	52
"	Dornoch, St. Gilbert's	2·32	59
"	Tongue Manse	2·35	60
"	Melvich Schoolhouse	..	..
XX.	Dunmanway Rectory	4·59	117
"	Mitchelstown Castle	..	..
"	Gearahameen	9·50	241
"	Darrynane Abbey	..	..
"	Cashel, Ballinamona	3·49	89
"	Roscrea, Timoney Park	2·68	68
"	Broadford, Hurdlestown	4·80	122
XXI.	Kilkenny Castle	3·00	76
"	Rathnew, Clonmannon	3·10	79
"	Hacketstown Rectory	3·71	94
"	Balbriggan, Ardgillan	2·45	62
"	Drogheda	2·49	63
"	Athlone, Twyford	..	..
XXII.	Castle Forbes Gdns.	3·57	91
"	Ballynahinch Castle	..	..
"	Galway, Grammar Sch.	5·25	133
XXIII.	Westport House	..	..
"	Enniskillen, Portora	2·91	74
"	Crossdoney Kent Cas.	3·23	82
"	Armagh Observatory	2·54	65
"	Warrenpoint	2·91	74
"	Belfast, Cave Hill Rd.	2·68	68
"	Glenarm Castle	2·98	76
"	Londonderry, Creggan	2·78	71
"	Sion Mills	2·55	65
"	Milford, The Manse	3·03	77
"	Narin, Kiltoorish	3·40	86
"	Killybegs, Rockmount	5·31	135

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° F.
London, Kew Observatory	1007·9	−6·0	68	14	26	2	50·7	36·9	43·8	−3·5
Gibraltar	1016·9	+1·6	78	26	47	20, 30	70·1	53·5	61·8	+0·5
Malta	1016·0	+3·5	80	28	44	8	67·8	56·5	62·1	+2·4
Sierra Leone	1012·1	+1·1	92	7	71	9	87·7	74·1	80·9	−1·9
Lagos, Nigeria	1010·2	+0·4	90	9	71	2	88·2	75·9	82·1	−0·2
Kaduna, Nigeria	1011·8	+1·1	96	1, 12	63	20	91·3	69·6	80·5	−2·0
Zomba, Nyasaland	1013·2	+1·3	90	29	54	7	79·7	59·4	69·5	+0·2
Salisbury, Rhodesia	1012·5	−1·9	89	3	46	6	82·6	51·9	67·3	+1·4
Cape Town	1017·2	+0·9	102	4	47	12	73·9	54·4	64·1	+1·0
Johannesburg	1017·4	+1·5	80	22	46	19	73·4	52·4	62·9	+3·3
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	..	..	85	12	44	14	80·6	50·6	65·6	+4·8
Calcutta, Alipore Obsy.	1006·2	−0·1	103	16	69	9	97·5	77·1	87·3	+1·6
Bombay	1008·1	−0·5	93	25	72	1	90·5	78·6	84·5	+1·4
Madras	1011·0	+2·8	106	22	73	8	93·8	78·2	86·0	+0·7
Colombo, Ceylon	1009·5	+0·4	95	5	71	11	89·5	76·2	82·9	+0·2
Hong Kong	1012·8	+0·2	85	22	61	1	75·7	67·6	71·7	+0·8
Sandakan	..	..	92	30	74	8. 12, 18	87·4	75·8	81·6	−0·6
Sydney	1017·2	−1·2	91	20	53	7	78·1	60·2	69·1	+4·5
Melbourne	1016·7	−2·7	94	17	41	2	70·1	53·2	61·7	+2·2
Adelaide	1017·1	−2·7	93	16	48	5, 8	74·6	57·4	66·0	+2·2
Perth, Western Australia	1016·8	−1·6	95	12	47	30	75·9	55·3	65·6	−0·8
Coolgardie	1015·5	−3·0	97	13	38	30	78·2	54·9	66·5	+1·4
Brisbane	1017·9	+0·5	91	13	58	25	82·3	62·7	72·5	+2·1
Hobart, Tasmania	1011·3	−3·2	84	17	37	25	63·5	47·9	55·7	+0·6
Wellington, N.Z.	1014·9	−2·9	71	20	39	23, 26, 27	64·3	51·1	57·7	+0·9
Suva, Fiji	1009·9	−0·7	88	10	67	28	84·9	69·8	77·3	−1·4
Kingston, Jamaica	1016·2	+1·9	91	15	65	1	87·8	69·6	78·7	+0·3
Grenada, W.I.	1015·4	+2·8	87	22	69	1	83·4	73·1	78·3	−0·5
Toronto	1017·4	+1·9	78	10	25	21	55·0	35·9	45·5	+4·1
Winnipeg	1017·4	+0·4	73	22, 23	17	19	52·3	30·7	41·5	+3·7
St. John, N.B.	1013·6	0·0	60	9	27	6, 23	46·2	32·9	39·5	+0·5
Victoria, B.C.	1020·2	+2·9	67	25	35	12	52·7	40·2	46·5	−1·2

LONDON, KEW OBSERVATORY.—Prevailing wind direction N, mean speed 9·2 mi/hr. 3 days with snow, 2 days with hail, 1 day with thunder heard.

GIBRALTAR.—Prevailing wind direction NW.

MALTA.—Prevailing wind direction WNW. 3 days with hail.

SIERRA LEONE.—Prevailing wind direction SW. 2 days with tornado, 3 days with thunder heard.

LAGOS.—Prevailing wind direction SW.

SALISBURY, RHODESIA.—Prevailing wind direction SE.

COLOMBO, CEYLON.—Prevailing wind direction WSW, mean speed 4·4 mi/hr. 4 days with thunder heard.

British Empire, April 1922.

TEMPERATURE				PRECIPITATION				BRIGHT SUNSHINE		
Mean Wet Bulb. °F.	Absolute Min. on Grass °F.	Relative Humidity %	Mean Cloud Am'nt 0–10	Amount in.	Amount mm.	Diff. from Normal mm.	Days	Hours per day	Percentage of possible	STATIONS
41·1	19	72	6·7	2·60	66	+ 29	15	4·7	34	London, Kew Observatory.
55·5	44	70	2·7	0·13	3	– 65	2	..	..	Gibraltar.
55·9	45	69	4·2	0·11	3	– 17	2	8·7	66	Malta.
73·8	..	67	4·0	4·45	113	+ 10	10	..	..	Sierra Leone.
77·9	69	74	7·5	7·42	188	+ 39	15	..	..	Lagos, Nigeria.
70·1	..	65	1·0	5·24	133	+ 65	7	..	..	Kaduna, Nigeria.
..	..	76	4·1	1·17	30	– 75	7	..	..	Zomba, Nyasaland.
58·6	..	52	1·3	0·00	0	– 26	0	..	..	Salisbury, Rhodesia.
58·4	..	68	5·2	1·12	28	– 23	9	..	..	Cape Town.
50·7	40	56	2·6	0·59	15	– 37	4	9·3	82	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
51·2	..	46	1·9	0·00	0	– 54	0	..	..	Bloemfontein.
76·9	65	46	3·6	1·19	30	– 14	3*	..	..	Calcutta, Alipore Obsy.
77·5	60	69	2·7	0·00	0	– 2	0*	..	..	Bombay.
78·2	69	69	2·3	0·00	0	– 15	0*	..	..	Madras.
78·5	68	66	7·0	8·30	211	– 41	16	..	..	Colombo, Ceylon.
67·1	..	81	7·6	2·02	51	– 89	7	5·1	40	Hong Kong.
77·4	..	87	..	10·64	270	+164	12	..	..	Sandakan.
62·2	47	60	4·5	1·30	33	–105	8	6·5	58	Sydney.
55·8	32	64	6·9	1·39	35	– 22	11	..	..	Melbourne.
57·5	36	56	6·1	1·51	38	– 8	9	4·8	43	Adelaide.
59·7	41	61	3·8	2·71	69	+ 28	5	7·8	69	Perth, Western Australia.
58·9	36	48	5·1	0·94	24	0	5	..	..	Coolgardie.
66·9	47	66	3·0	0·27	7	– 84	4	..	..	Brisbane.
49·9	30	66	6·5	2·01	51	+ 3	16	5·8	53	Hobart, Tasmania.
53·1	27	74	5·8	1·12	28	– 71	12	5·6	51	Wellington, N.Z.
75·3	..	87	6·3	12·41	315	+ 28	17	..	..	Suva, Fiji.
..	..	71	5·3	0·10	3	– 28	2	..	..	Kingston, Jamaica.
72·7	..	71	5·3	1·26	32	– 28	16	..	..	Grenada, W.I.
39·2	19	73	5·0	3·77	96	+ 35	14	..	..	Toronto.
37·7	..	77	4·8	0·52	13	– 25	8	..	..	Winnipeg.
36·1	21	80	6·9	2·49	63	– 26	13	..	..	St. John, N.B.
42·2	27	78	6·3	0·73	19	– 25	8	..	..	Victoria, B.C.

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

HONG KONG.—Prevailing wind direction E, mean speed 12·0 mi/hr. 1 day with thunder heard. 1 day with fog.

SANDAKAN.—Prevailing wind direction NE.

SYDNEY.—Maximum temperatures highest on record for April.

MELBOURNE.—Maximum temperature highest on record for April for 67 years.

PERTH, W.A.—Mean speed of wind 7·1 mi/hr.

WELLINGTON, N.Z.—Prevailing wind direction NNW.

SUVA, FIJI.—Prevailing wind direction easterly.

GRENADA, W.I.—Prevailing wind direction E.

(*Continued from p.* 257.)

A few days later the U.S. liner *Resolute* encountered a cyclonic disturbance in mid-Atlantic, which was stated to have been the worst storm in the captain's knowledge.

On the 21st a very severe hurricane swept the island of Bermuda. The damage to property from the wind, and subsequent abnormal tide, was estimated to reach nearly a quarter of a million sterling, and it is remarkable that only one life appears to have been lost. The hurricane was considered to be the worst one experienced in this island during the last quarter of a century.

A typhoon broke over Chefoo (Shantung) on the 2nd and lasted for 36 hours, but the damage done was not very extensive.

Excellent rains were recorded throughout South Australia during the month and there was every prospect of a really good harvest. The other States also had good rainfalls.

The special message from Brazil states that the distribution of rain in the north and central regions was very irregular, some parts having a fall exceeding the normal and others a deficit. In the southern area the rainfall averaged 39 mm. below normal. Small high pressure areas with very active wind circulations prevailed throughout the month and temperatures were generally high. The state of the crops was satisfactory on the whole.

Rainfall in the British Isles.

DURING the month, roughly half the area of the British Isles received a rainfall below the average. This area was mainly in the centre and south of England, the north coast of Ireland, and included practically the whole of Scotland. The deficiencies were nowhere very large, amounting to more than 40 per cent. only in the Western Highlands. An excess of more than 50 per cent. occurred in Pembrokeshire, Suffolk, and the north-eastern coast of England, and at Newcastle more than twice the average fell. The distribution of the total rainfall of the month over the British Isles was rather more uniform than is usual at the season. Falls of less than 50 mm. (2 in.) occurred mainly in the south of England from London to Yeovil, and in Scotland in the neighbourhood of the Moray Firth and Loch Ness. In eastern Kent falls of more than 100 mm. (4 in.) were widespread, a notable feature of the month. Falls of more than 250 mm. (10 in.) were confined to the English Lake District and Snowdonia.

The general rainfall, expressed as a percentage of the average, was :—England and Wales 123, Scotland 87, Ireland 117, British Isles 110.

In London, Camden Square, the mean temperature for September was 55·5° F., or 2·2° F. below the average.

Duration of rainfall, 37·0 hours; evaporation, 1·11 inch.

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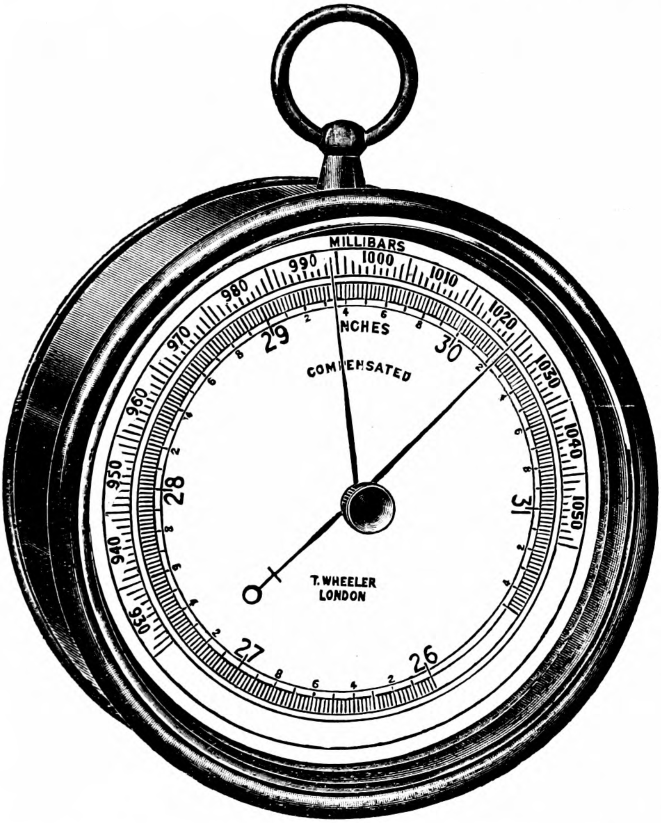
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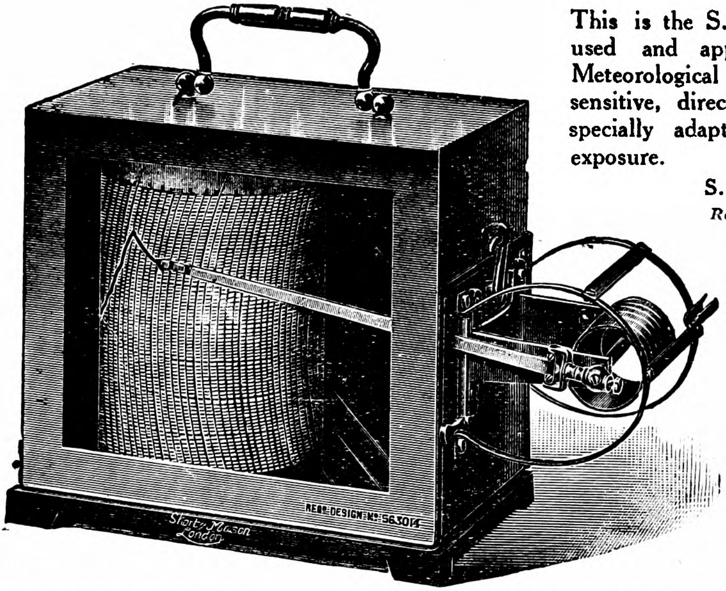

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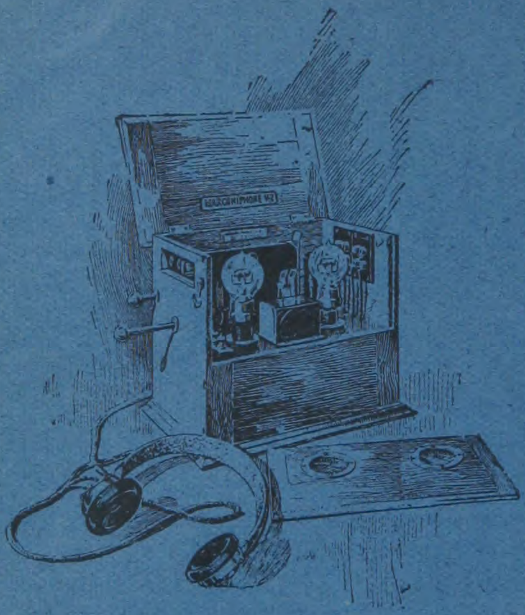

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THE METEOROLOGICAL MAGAZINE.

No. 682
NOVEMBER 1922
Vol. 57

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NOVEMBER, 1922.

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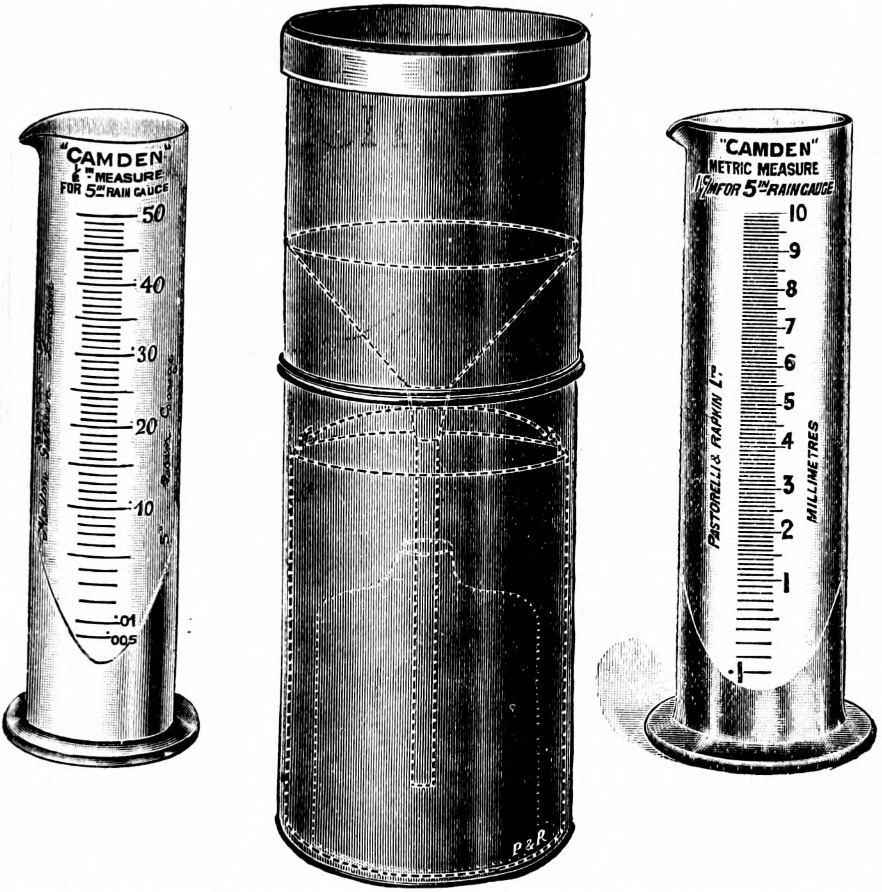

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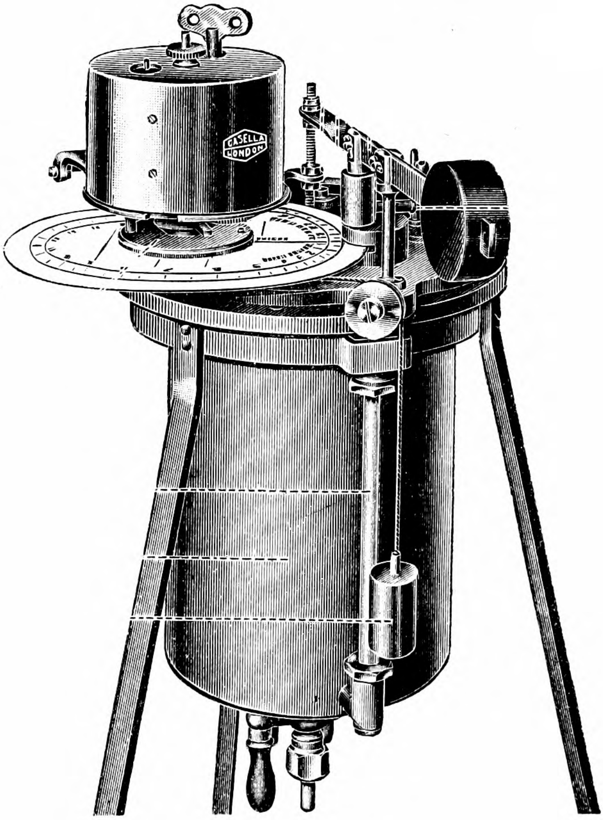

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The Royal Aero Club Gliding Competition, October 16th to October 21st, 1922.

The Meteorological Conditions.

By Captain F. ENTWISTLE, B.Sc.

THE Gliding Contest at Itford Hill, near Newhaven, for the prize of £1,000, offered by the *Daily Mail*, opened rather quietly, but the finish was as brilliant as it was unexpected when, on the last afternoon, M. Maneyrol, one of the two French competitors, wrested the world's record for gliding from Germany by remaining in the air for 3 hr. 21 min.

For some weeks prior to the contests, many people had somewhat vague ideas regarding the meteorological conditions which were necessary for soaring flight. The idea was prevalent in many quarters that the requisite condition was the development by the pilot of a miraculous " bird-sense," so that by taking momentary advantage of a gust here and a gust there he was able to keep aloft without losing height. No one who witnessed the gliding on the South Downs can doubt that skilful piloting is necessary, but, in addition to this, the first requirement is an area of persistently and steadily rising air, sufficiently strong to form an effective resistance to the descent of the machine, which would otherwise glide down to the ground at an angle depending on its design. Such conditions are found in practice in the case of a wind blowing against a ridge of hills or mountains, the mechanical effect of which is to produce an upward current which is strongest just above the crest of the ridge on its windward side. The gliding contest has made it clear that, given a sufficiently strong wind, a sufficiently stable and controllable glider

* (64)18955 Wt 69—P 1 1000 11/22 E & S A 2

and the right pilot, the latter can remain soaring above the ridge indefinitely, provided he remains in the upward current.

The selection of the site for the contest was made at a meeting of the Gliding Committee of the Royal Aero Club on the 14th September, at which the writer was present. Some doubt had been expressed as to the possibility of finding a suitable hill sufficiently high, having regard to the height of the Wasserkuppe, the scene of the German gliding triumphs. But there did not appear to be any reason why a hill 500 to 1,000 feet in height, provided that it was steep enough, should not give the required vertical current. The proposed site on the South Downs was favoured largely on account of its accessibility. Itford Hill had been suggested originally, with a view to gliding in a south or south-west wind; but it was pointed out, that in October, winds from north and north-east preponderate on the average.* However, as the whole ridge, parts of which face northward and north-eastward, would be available for the competition if necessary, this objection was not regarded as insurmountable. Actually north-easterly winds prevailed throughout the week of the competition, so that it became necessary to transfer the theatre of operations eastward during the week.

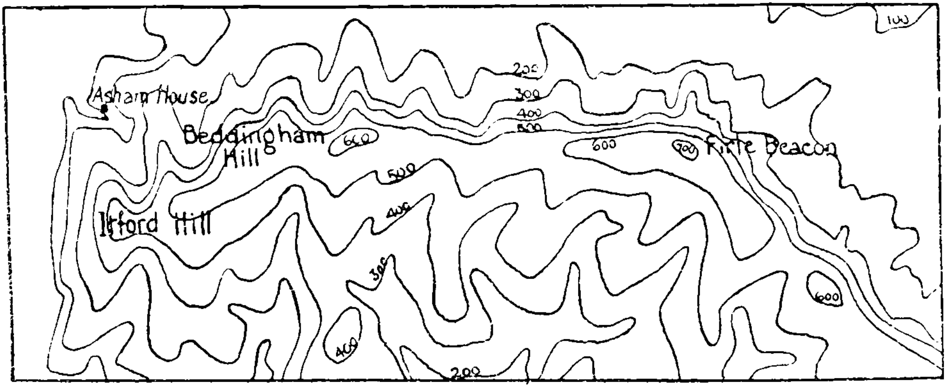

Fig. 1. The South Downs, east of the River Ouse

The meteorological arrangements included the measurement of winds at different altitudes and the supply of this information, together with daily forecasts. Surface winds were measured by an air-meter and, in the case of the strong winds experienced during the latter half of the week, by a swinging plate anemometer. For upper winds, pilot balloons sent up from the valley were

---

* [This generalization is based on a discussion of the wind directions registered at Eastbourne and Brighton during the last ten years. The statement is not valid for the flow of air over south-east England as a whole. The north winds along the south coast probably represent the autumnal land breeze which prevails when the land is colder than the sea.—Cf. *M.O. Circular*, No. 42, p. 4; No. 43, p. 3; and *The Met. Mag.*, Sep. 1920, p. 177.—Ed., M.M.]

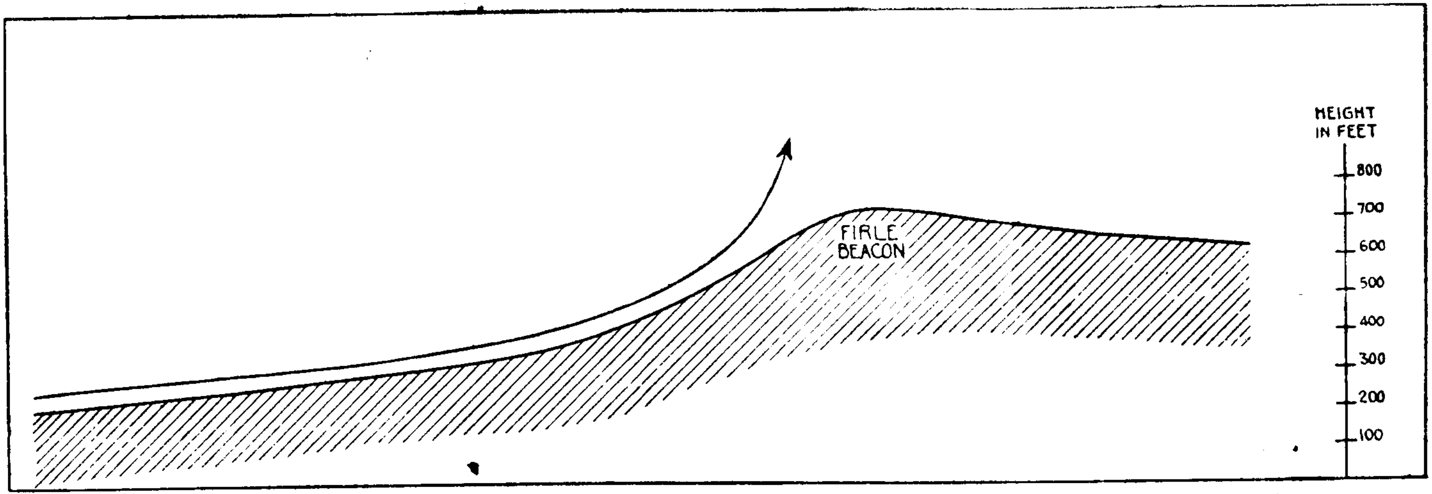
HEIGHT IN FEET
800
700
600
500
400
300
200
100
FIRLE BEACON

FIG. 2.—Section through Firle Beacon from north-east to south-west. Path of balloon with no " lift ".

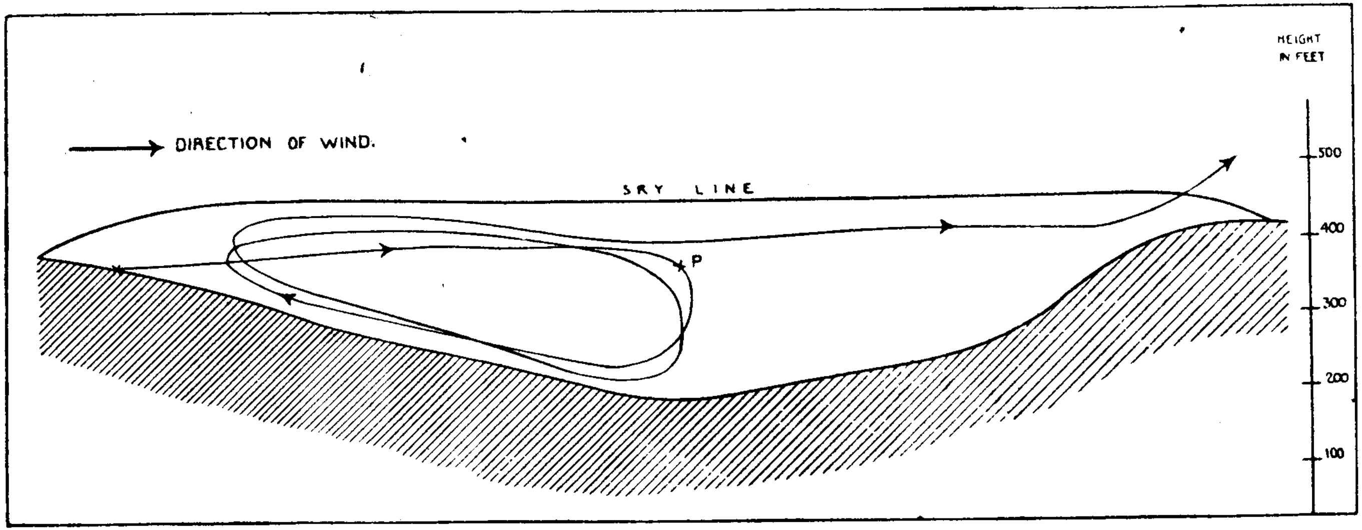
DIRECTION OF WIND.
SKY LINE
P
HEIGHT IN FEET
500
400
300
200
100

FIG. 3.—Path of a balloon with no " lift " across the valley between two spurs on the north of Itford Hill.

followed by a single theodolite, and the direction and speed of the wind at different heights were determined by means of the " tail method," which also enabled a measure of the vertical currents to be obtained. Apart from the special merits, or demerits, of this method, it was realised that the information obtained from single ascents would not be of great immediate value owing to the configuration of the surroundings. The wind currents in the neighbourhood of the ridge were, therefore, investigated chiefly by means of free balloons having no lift, a method which had the additional advantage of giving immediate information to interested spectators.

The contour map of the trial ground (Figure 1) shows that the northern side, which extends from Itford Hill to Firle Beacon, the highest point of the ridge, is very steep. Spurs jut out from it northwards forming a series of short, cup-shaped valleys. On the other side of Firle Beacon the ridge runs from north-west to south-east and the north-east flank is less irregular.

The result obtained from a balloon in the normal case of a north-east wind blowing at right angles to the hill is shown in Figure 2, which represents a section through Firle Beacon from north-east to south-west, drawn to scale. The upward current referred to previously is shown very clearly.

In the case of a north-east wind, very curious effects were observed in valleys on the north side of the ridge. Figure 3 represents a section across the first valley, just below Itford Hill. The section is not taken parallel to the ridge, indicated by the words " sky line " in the diagram. Roughly speaking, the sky line runs east and west, the section north-east and south-west. A balloon was liberated from the top of the eastern spur so that it would travel across the valley. Another balloon, released previously farther from the ridge, at the bottom of the spur, followed closely the contours of the ground, a result found almost invariably during the week in the case of small slopes. But the second balloon moved in the direction of the wind to a point *P* in the centre of the hollow, where it remained stationary for several seconds. It then descended and came back up the leeward slope of the spur practically to the point of departure. This circuit was completed a second time, after which the balloon rose rather higher than before and was carried across the valley, rising over the top of the western spur and finally descending behind the ridge. Similar eddy effects were observed in the other valleys. At least two competitors came to grief through gliding from the western edges of these valleys; starting places could be found where the wind blew straight up the slopes, but the eddies in the valley made gliding hazardous. It was not surprising that most pilots preferred to take their machines to the other side of Firle Beacon, where the wind was normal to the ridge. This area, however, was not without its pitfalls. A short spur runs north-eastward from Firle Beacon where the ridge bends, and balloons liberated from the two sides of this spur travelled upwards in different directions, revealing a distinct " air-parting." It was, therefore, desirable to avoid the edge of the ridge when gliding.

The results obtained during the week point to the fact that for successful soaring flight, the ideal conditions are a straight or slightly concave ridge and a fairly strong, steady wind blowing at right angles to it. The slope of the ridge on the windward side is of greater importance than its height. The actual strength of wind required depends, of course, on the type of machine used.

Another point which has been overlooked is that the strength of the ascending current, the production of which is largely mechanical, depends to some extent on the prevailing atmospheric conditions, particularly the vertical temperature gradient. If the lapse rate is large and convection is going on freely, the vertical current will be reinforced. This was observed during the flight of M. Maneyrol, the winning pilot, on the afternoon of the 21st. Heavy banks of cumulus and cumulo-nimbus cloud, which followed one another in quick succession from the north-east, were evidence of strong convectional circulation. The glider was observed to rise appreciably as these passed overhead.

This new branch of aeronautics has opened up an interesting and important field of investigation, fascinating alike to the meteorologist and to the aviator, in which little has hitherto been done.

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THE new anemograph station at Aberdeen is situated in an open field due east of the Observatory and about a quarter of a mile distant from it. The exposure is, therefore, less gusty than that of the Robinson anemometer, which is erected on top of the Observatory and surrounded by the buildings of King's College and the neighbouring part of the town.

The hut is erected within an enclosure measuring 60 ft. by 50 ft., with an 8 ft. corrugated iron fence around it; the vane is roughly 40 feet above the ground. The ground slopes downward from north to south, and very gently downward both to east and to west. In the north-east corner of the enclosure a small platform has been erected around a concrete pillar; the top of the pillar is about 9 feet above the ground, and carries the " wall-head " for the Watts Theodolite. A clear view all round is thus obtained which will be advantageous for pilot-balloon work.

The Estimation of Cloud Amount on Days of Fog or Mist.

THE problem how fog and mist are to be allowed for in arriving at estimates of cloud amount is a difficult one. We know that the condition most favourable for the formation of fog is the presence of a clear sky overhead, and in fact it often happens that an observer who is himself immersed in a fog can see through it and realise that there is bright sunshine a few feet above his head. Another recurring problem is offered by the day when the sky is covered by a thin veil of cloud which may perhaps be manifest only by the halo. Are the cloud amounts 0 or 10?

Experience has shown that the instructions hitherto given for the guidance of observers needed to be amplified, and the following rules have been adopted at the telegraphic reporting stations and observatories of the Meteorological Office, with a view to their incorporation in due course in official books of instructions to observers :—

> *Entry of Cloud on occasions of Fog or Mist.*—If the vertical thickness of the fog is so great that it is impossible to tell whether there is cloud above it or no, the cloud amount should be entered as 10. This applies, for example, to all cases of fog in the daytime in which the sun is *quite* invisible. If cloud can be seen through the fog, then the amount should be estimated as well as possible and entered in the ordinary way. The form can also be recognised under these conditions more or less correctly and should be noted. If the sun or stars can be seen through the fog and there is no evidence of cloud above the fog, the amount of cloud should be entered as 0, irrespective of the *horizontal* thickness of the fog.
>
> *Very thin clouds.*—It is to be noted that the "amount" of cloud under existing international practice has no relation to the thickness of the cloud. If therefore an observer can be sure from any sign in the sky that the air contains condensed water (or ice) the proportion of the sky covered by this cloud should be estimated.

State of the Ground.

OBSERVATIONS of the state of the ground are now taken at the four regular daily hours of observation used for telegraphic reports at the Observatories and Distributive Stations of the Meteorological Office. A figure code running from 0 to 9 enables the primary characteristic of the state of the ground to be reported by telegraph. Thus it is indicated whether the ground is dry or wet, frozen or covered with snow. If there is skating or there are glazed roads, this can be reported. The observations made at 1 p.m. have been published in the *Daily Weather Report* from the 1st of November.

Discussions at the Meteorological Office.

October 30th, 1922. *Wet Bulb Temperatures and the Thermodynamics of the Air.* By C. W. B. Normand (Memoirs of the Indian Meteorological Department. Vol. 33, Part 1, 1921, pp. 1–21). Opener—The Author.

At the meeting on October 30th, the Meteorological Office welcomed Dr. Normand, on leave from Simla, who gave an account of his own work on thermo-dynamics.

As was brought out in the course of this discussion the term wet-bulb temperature is very ambiguous. For the purpose of this summary it seems better to utilise the term adiabatic saturation temperature, which may be defined as follows:—

Given air in a certain state and water at a certain temperature such that the cooling of the air to that temperature would provide the heat necessary to evaporate sufficient water to saturate the air, the total pressure remaining constant, the temperature in question is the adiabatic saturation temperature of the air. The abbreviation A.S. temperature will be used.

Dr. Normand would take the wet bulb temperature obtained with forced ventilation as equivalent to the A.S. temperature. Subsequent speakers regarded the approximate identity as more or less accidental, basing their opinion on the results of experiments* with liquids other than water and gases other than air.

The central ideas of Dr. Normand's paper are stated most readily in terms of the Neuhoff diagram. It appears that when air is moved from one level to another, the A.S. temperature follows the adiabatics for saturated air, and this regardless of of whether condensation or evaporation is taking place, the only condition being the absence of effective radiation and exchange of heat with other air masses.

A striking example of the use of the theory in testing the homogeneity of air may be quoted. Many observers have noted the increase in temperature and fall in humidity in the interior of tropical cyclones; in such circumstances we should expect to find almost adiabatic conditions and constant wet bulb temperature. The observations of the temperature and humidity on the occasion of the Manila typhoon, October 20th, 1882, were examined to see if this were correct, and it was found that, though the dry bulb temperature rose 7·8° F. and the humidity fell from 100 per cent. to 50 per cent., the variation to the wet bulb temperature amounted to a fall of only 0·4° F.

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* Cf. *Zur Kenntniss des Ventilierten Psychrometers.* By A. Svensson. Akad. Abh. Stockholm, 1898.

Potential A.S. temperature may be defined as the A.S. temperature which would be assumed by the air (with any vapour and liquid water it contains) if it were brought adiabatically to standard pressure. To a close approximation, potential A.S. temperature is an invariant in adiabatic changes even when the liquid water is precipitated. It follows that to the same order of approximation, the entropy of the air is a function of its potential A.S. temperature. The potential A.S. temperature of the atmosphere increases with increasing height in temperate regions, but decreases in the tropics, and a like generalization therefore applies to entropy.

Such statements have to be interpreted with great care, however. Sir Napier Shaw gave it as the result of his experience that the safest course was to regard the dry air as the "working substance" in thermo-dynamical processes and to regard the moisture contained in it as a source of heat by which entropy would be increased on condensation. Allowance could be made for the effect of the moisture on the density, but, if that were omitted, the results were still sufficiently accurate for working purposes.

An account of the discussion on October 16th of Prof. V. Bjerknes's paper *On the Dynamics of the Circular Vortex*, which was opened by Sir Napier Shaw, will be published in the next issue of this magazine.

The subject for discussion on Monday, November 27th, 1922, at 5 p.m., will be: *Die Zirkulation der Atmosphäre in den gemässigten Breiten der Erde.* (The Circulation of the Atmosphere in the Temperate Latitudes of the Earth). By A. Defant. Stockholm. *Geog. Ann.*, III., 1921, pp, 209-66. The discussion will be opened by Mr. R. G. K. Lempfert.

Correspondence.

To the Editors, *The Meteorological Magazine*.

Change of Wind on the Turn of the Tide.

APROPOS of Capt. Hepworth's suggestion that the weather changes with the turn of the tide, to which I referred in a note on *Weather Lore* in the February Number of this magazine, my attention has been called by Dr. C. F. Brooks to two short articles on the subject by Mr. H. M. Plummer in the *Bulletin of the American Meteorological Society*, Oct.–Nov. 1921, and March, 1922.

In the first note Mr. Plummer asks for an explanation of the sudden increase of south-west wind on the turn of the tide which he has observed on many occasions on the southern coast of New England between Point Judith and Monomoy Point.

He notices that the phenomenon is especially frequent in spring and most marked between 8 a.m. and 3 p.m. It is always preceded by a calm, with warm sun, and may be repeated for many days in succession, an hour later each day, and with the wind daily decreasing in violence; it does not occur in winter nor at night nor in cloudy weather, but may occur during fog. Mr. Plummer notes also that it is the south-west wind alone which occurs on the turn of the tide and that it comes only at the beginning of the ebb or western tide.

In the second article Mr. Plummer himself suggests an explanation, namely that at night a layer of cold air forms at the surface of the sea; the wind, which rises during the day, flows over the top of this cold layer and, aided by the sun's radiation, gradually wears away the layer and also sets it in motion. If the tide be running in the same direction it will set the cold air in motion at the surface and when the tide turns, this motion at the surface is checked and in consequence becomes turbulent; the thin cold layer of air is blown away, and the wind establishes itself at the surface.

NAPIER SHAW.

Nov. 4th, 1922.

North-East Wind, but Squally Weather.

WEATHER sufficiently rare to seem worthy of special note was experienced at Cranwell, Lincolnshire, during October 18th and 19th.

The isobaric distribution on the 7 h. map of the 18th showed an extensive anticyclone centered over Scandinavia, the isobars over the British Isles being of anticyclonic curvature. The same isobaric distribution was shown by the 7 h. synoptic map on the 19th and the curvature of the isobars over these Islands still remained anticyclonic.

During the two days in question, the feature of the weather at Cranwell was the succession of heavy showers. Each shower was accompanied by a squall, the wind, as registered at 43 feet above the ground, rising from the general mean, between 10 and 15 miles per hour, up to 25 or 30 miles per hour. Each squall was accompanied by a rapid backing of the wind from the general mean of ENE or NE to N or even NNW, the backing only lasting for a minute or so. Each squall, too, was accompanied by an arch of cloud, cumulo-nimbus or nimbus in type, which bore a marked resemblance to the cloud formation accompanying line-squalls, and the precipitation was heavy rain or sometimes rain with a little hail. At least 15 such showers occurred in the two days.

The showers were travelling from east to west and the peculiarity of the phenomena seems to me to lie in that east-to-west motion. It might be explained by the passage of small cyclonic sinuosities round the southern side of the anticyclone moving from east to west. In any case I do not remember ever having noticed the same thing—the travel of so many squalls from an easterly to westerly point in conjunction with such a pressure distribution—and it would be interesting to know if such weather was really unique. Happily in this case the appearance of the sky, coupled with reports of extreme bumpiness from air-pilots, enabled the showers to be forecasted correctly, though the map might not have led one to suppose them so certain.

W. H. Pick.

October 23rd, 1922.

The situation described by Captain Pick may be summed up by saying that the weather was of a north-westerly type (squalls and showers), while the wind was easterly. The north-westerly type gets its features from the fact that cold polar air has passed over a long stretch of warm sea on its way to these shores. If air from the Spitzbergen neighbourhood comes down to us over the Baltic and North Sea there seems no reason why, at this time of the year, it should not get the same features as north-westerly air and this is probably what happened on October 18th and 19th. The difference is that, whereas north-westerly air from polar regions is bound to come over a warm sea area before reaching us, it requires a very nice adjustment in the case of air reaching us from polar regions via an easterly course.

J. S. Dines.

October 26th, 1922.

Shallow Winds.

With reference to Mr. H. Harries's letter on shallow east winds, may I recall a remarkable case of a shallow wind which I experienced on July 23rd, 1911? I was sailing eastward from Helford to Fowey on that day; at one time, when about four or five miles off the coast we were on the starboard tack with a southerly wind, and making, to the best of my recollection, three to four knots; about a couple of miles nearer the shore the yacht *Laverock* was sailing at about the same pace, but she was on the port tack with a northerly wind. As far as I remember these conditions persisted for about an hour; at one time while we were on the starboard tack I made out thistledown overhead coming from the north. Our southerly wind died away gradually, but before it dropped entirely, and while the sails were still drawing, the burgee at the mast head, about 75 feet above the deck, was in a very light northerly breeze.

C. J. P. Cave.

Stoner Hill, Petersfield, October 20th, 1922.

Cloudbands and Wind Forecasts.

WITH reference to the fan-like appearance of parallel cloud bands in the sky, Mr. W. F. Dale writes as follows :—

" It is thirty years ago, when I was living in the Falklands, that I first came to connect the fans with a change of wind. I thought at that time the phenomenon might be peculiar to the southern hemisphere; but when I came back to England I found just the same thing here. My observation, extended over this number of years, would lead me to say without any hesitation that the appearance of two opposite ' fans ' indicates a change of wind, and that within 24 (or 36) hours the wind will be coming from the quarter occupied by the second fan, *i.e.*, it will be blowing from the quarter opposite to the wind which prevails when the fans appear. The reasons I have not spoken about this (shall I call it discovery?) before, are two—first, I thought it had probably been noted ' since Adam threw away the core,' and, second, because it apparently failed occasionally say, once in five or six times. But further observation has convinced me that what happens in the apparent failures is that the new wind is not sufficiently strong to overcome the prevailing wind and after, perhaps, bringing about a calm or a drift of smoke from the chimneys in the opposite direction for an hour or so, the prevailing wind resumes its sway. . . . I would say that the fans always indicate a change of wind. I would *not* say that a change of wind is always indicated by fans, though they may perhaps be sometimes hidden by a lower stratum of clouds. . . . To be of much practical use the study of this phenomenon should enable the skipper of a ship to determine from the look of the fans what the *force* of the new wind may be expected to be and to say to the first mate : ' Those are good fans, now we shall be all about ! '

May I suggest that there is a case for inquiry? "

WALTER F. DALE.

" Minerva," Upper Parkstone, Dorset, October 25th, 1922.

Seasonal Variation of East Wind: A Correction.

IN my letter on this subject in the October number of *The Meteorological Magazine* the point of my argument was nullified in the unfortunate printing of *unheated* where I had written *sun-heated.* My point was that the continental mainland warms up so rapidly that by May easterly currents tend to reach south-east England as warm land winds, unless they have a decided northerly component. We know that the continent often becomes highly heated in May. L. C. W. BONACINA.

27, Tanza Road, Hampstead, N.W.3, October 18th, 1922.

A Persistent Rainbow: Porlock, September 16th, 1922.

On the afternoon of September 16th, whilst driving over Dunkery Beacon, I witnessed an unusual rainbow effect. Up on the Beacon a thick Scotch mist prevailed, but as the conveyance descended the hillside towards Porlock the mist lifted somewhat and, looking in the direction of Porlock (north-east), the hillside near Hurlstone Point was seen to be bathed in sunshine, causing the grass slopes to appear a very vivid green. Superimposed upon this brilliant scene was a magnificent rainbow, which remained visible for nearly an hour and a half. The sky was about nine-tenths covered with cloud and the clear patch through which the sun was able to light up the hillside remained in practically the same position throughout. I should imagine that the rainbow was formed by a very fine drizzle, as the arc was large and covered the entire hillside. Moreover, I viewed the bow from a great elevation (almost 1,000 ft. at first) and the bow was still visible when I reached the valley. The colours of the bow were all present, but were not sharply defined. The effect was " smudgy " or blurred, the colours appearing to run into each other. The points that were most striking were the intensely vivid, bright green of the hill sides contrasting with the colours of the bow and the clear patch of blue sky practically stationary, the rest of the sky, low driving fracto-status.

F. J. Parsons.

County Observatory, Ross-on-Wye, October 25th, 1922.

The Porlock Valley runs inland from the British Channel towards east-south-east, the Exmoor hills, 1,000 ft. and upwards on one side, Bossington Hill, about 700 ft. on the other. Throughout the day in question, September 16th, 1922, the general flow of air, as shown in the *Daily Weather Report* maps, was from south-south-west. The persistent patch of clear sky over the valley seems to be explained by the descent of the air from Exmoor. On the other hand, the drizzle-producing cloud over Bossington Hill may have been fed by the damper air coming up the valley from Porlock, this damp air being scooped up by the upper current. It is remarkable that the conditions should have been so stable as to give such a persistent rainbow. The smudginess of the bow indicates very small rain-drops.

Such an explanation as has been given of this distribution of cloud seems to be necessary in the case of the " Helm Bar." The Helm Bar* is frequently seen in the Eden Valley when an east wind blows across the Pennine Range in the neighbourhood of Cross Fell. The Range is covered by the Helm Cloud and, at a distance of a mile or two and at a lower level, the Helm Bar is formed. The Bar is stationary, being continually reinforced by condensation on the windward side. It seems clear that the moisture evaporating at the base of the Helm Cloud could not condense again at a lower level and that the existence of another source of air supply must be a necessary condition for the phenomenon. The known distribution of wind near the ground is consistent with this theory. F. J. W. W.

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* See *Q.J.R. Met. Soc.*, 1889. Vol. XV., p. 103.

November 2nd, 1922.

The Red Rainbows of July 30th, 1922.

ON turning up my own observations for July 30th I find :—" Red rainbow, faint. Strong fiery glow on clouds in SW-NW. Bow all red, only faint trace of green." It was the conjunction of a strong sunset glow and a shower which led me to look for the bow. The time was after church on the Sunday evening, July 30th, I believe about the time Mr. Harries saw his bow.

CICELY M. BOTLEY.

10, *Wellington Road, Hastings, October 19th,* 1922.

The Green Flash.

IN August the sun sets into the sea at Bude. On August 23rd, 1922, a remarkably clear and beautiful sunset took place, and with a pair of field-glasses (which it is quite safe to use when the sun is really low on the horizon) the green flash was clearly seen, though observers with the naked eye told me they failed to see it. What was remarkable was that the arc of the sun turned green, and then also the chord made by the sea horizon, and for a fraction of a minute these two lines enclosed an orange space. This rapidly disappeared and the last segment was wholly green. I do not remember to have seen any description of such a flash before, but I think if observers would use glasses the green flash would much more frequently be recorded.

AGNES FRY.

Failand House, Bristol, October, 1922.

Earwigs and Recording Instruments.

I HAVE a Yale lock on my thermometer screen and for a time I was much annoyed by earwigs getting into the lock; they had the habit of dropping up my coat sleeve when unlocking. A drop or two of paraffin squirted into the lock has been most effective in keeping the lock clear—most instruments could be wiped round with a paraffin cloth. I have noticed that leaving one or two killed earwigs in the outer part of the rain-gauge seems effectively to keep others from intrusion.

CHAS. HARDING.

2, *Bakewell Road, Eastbourne, October 6th,* 1922.

NOTES AND QUERIES.

An Eighteenth Century Meteorological Diary.

It is always instructive to peruse early records of scientific work, but old meteorological diaries seem to possess a particularly personal interest, especially when they contain the results of observations made by one individual throughout a long lifetime. Such a record has recently been lent to the Meteorological Office by the Provost and Fellows of Lancing College and a summary of the manuscript books is now available in the Library of the Office.

This record is contained in two small manuscript volumes which represents the observations of a lifetime and give a diary of meteorological events extending over nearly 63 years, from 1733 to 1795.

The diarist, Thomas Barker, was born at Lyndon, in the county of Rutland, in 1722, and resided there until his death in 1809. He was a well-known and assiduous observer of meteorological phenomena and among his contributions to the Royal Society is a series of annual summaries of his observations at Lyndon. These summaries date from 1771 until a few years before Barker's death. Other papers from his pen will be found in the early *Philosophical Transactions of the Royal Society*, one of them dealing with the rainfall of the Lyndon district.

The two volumes of records are of different character. The first, which deals only with the period 1748 to 1763, contains both instrumental and eye-observations for each day of the year. Generally speaking, the instruments, barometer, thermometer and rain-gauge, were read twice daily at about 8 a.m. and 3 p.m. Barker did not always restrict himself to two observations *per diem*, but sometimes, when he thought the weather to be of particular interest, made several readings a day. Accompanying the instrumental readings are notes of wind force and direction, cloud velocity and direction, and present weather. To specify wind force a numerical scale is used, and a similar scale is employed to denote cloud velocity. The weather notes are full, and a brief monthly summary is given at the end of each month's observations.

The second volume contains only incidental references to instrumental observations. It consists of a continuous narrative of the weather from 1733 to 1795 and is written from the point of view of a farmer. The weather is described with particular reference to the yield of the staple crops and to the operations of seed time and harvest. Prices of the chief cereals are given frequently and details are mentioned of the effects of the weather on the rearing and health of farm stock. In addition, phenomena which seemed to Barker to be of outstanding meteorological interest are fully described, and a number of these formed the subjects of notices to the *Philosophical Transactions of the Royal Society*. The whole volume forms a most interesting record of agricultural meteorology.

C. E. BRITTON.

The Storm of March 4th, 1818.

CAPTAIN J. B. HEWETT writes:—

> " I WAS interested to observe the inscription '4th March 1818 Strong Wind' deeply carved in one of the stout oak beams of an ancient windmill at Bodle Street, a small hamlet about 9 miles north of Eastbourne in Sussex. . . . It occurred to me that a 'Strong Wind' which created in the mind of a man to whom observations of wind vagaries must have been a second nature, the desire to record the event in such a manner, must have been something extraordinary in the way of strong winds."

Reference to contemporary records, chiefly manuscript diaries in the possession of the Royal Meteorological Society, shows that the storm was very violent in the neighbourhood of London and at Boston, Lincs. J. W. G. Gutch in his list* of "Some of the remarkable meteorological phenomena that have occurred during the last thousand years" says:—

> "1818, March 4th. A tremendous hurricane throughout England, doing vast damage to the shipping."

Bellville in his excellent diary kept at Greenwich, says:—

> "About 8 o'clock p.m. [March 4th] a furious tempest began such as has not been known for many years—and lasted till midnight, great Elms in the park were torn up by the roots, many houses in the metropolis were completely levelled with the ground and many serious accidents followed, several lives lost and the damage at sea beyond description here. The tempest came from the South accompanied with much and continued rain and a great deal of lightning towards the close, the Bar. fell to 28·41 during the storm."

The Journal of the Royal Society has this remark against March 5th:—

> "Fair. A violent gale between 10 and 12 last night; baro. 28·6 at 11h. 30m."

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* *Quarterly Journal of Meteorology*, Vol. 1., 1843, p. 134.

While the Reverend James Cowe in his diary kept at Sunbury Vicarage, Middlesex, records that March 4th was " *Very* stormy."

The diary kept by a Mr. C. Soare, of London, is of special interest as he gives the barometric curves for each month; March shows a series of depressions, the storm of March 4th, 1818, giving the lowest reading, about 28·4 inches. His comment on the storm is :—

> " Forenoon fine, at 3 p.m. the Mercury began to descend, and at 11 p.m. it had fell 8½ degrees [*sic*] more than 1 for each hour, a complete hurricane from 7 to 10 at night attended occasionally with rain—and very bright all night and till noon."

Another Journal with copious remarks is that kept by Mr. Edwin at Clerkenwell. His entries for March 4th and 5th are :—

> " March 4th. Wind particularly violent, a perfect hurricane for about ½ hour . . . red flashes but not frequent . . . tiles fell off the houses in every direction.
>
> " March 5th. The newspapers this morning give a long account of the damage done by the Hurricane on Wednesday night . . . it blew in the roof of Surgeons' Hall in Lincoln's Inn Fields, a piece of lead about 2 cwt. also tore up a large tree by the roots in the square."

Luke Howard, in his *Climate of London,* against his own observations at Tottenham on March 4th, writes :—

> " Fine morning; the barometer which had gone somewhat lower rising abruptly; having risen about four-tenths, it took to falling again rapidly, there was a completely overcast sky (with haze in broad streaks, converging in the south-west, and moving swiftly under it) till dark; when it began to rain and the wind rose to a greater degree of violence than for some years past, ranging thus from south-east to south-west till past midnight; when it abated the barometer appears to have turned to rise more abruptly than before, having gone down an inch in 15 hours (the actual lowest point 28·35): there is said to have been much thunder and lightning after midnight; the barometer fell, not uniformly, but by fits, at intervals of about a quarter of a minute, as the more violent gusts of winds came over."

At Walthamstow he records :—

> " Very fine day, night violently stormy; wind and rain; lightning about midnight; then stars appear and aurora borealis."

And Mr. Cary, of the Strand, whose tables are incorporated in the *Climate of London*, remarks:—

> "March 4th, cloudy in the evening. The barometer fell to 28·55 and a violent storm succeeded."

The Boston journal referred to above records "a hurricane at night" on March 4th and "Rain and hail, heavy fall of snow" on the 5th.

The Total Eclipse of the Sun on September 21st, 1922.

SUCCESSFUL observation and photographing of eclipse phenomena depend entirely on favourable weather conditions.

On the morning of September 21st the sun was totally eclipsed on a narrow belt of the earth stretching from Somaliland across the Indian Ocean and Australia. Expeditions were made to most of the accessible stations on the track, including one from Greenwich to Christmas Island, which like Wallal, on the north-west coast of Australia, was a most favourable spot for observations on account of the high altitude of the sun. The principal purpose of the expeditions was the verification, by means of photographs, of the bending of the path of a ray of light in its passage through the sun's gravitational field, in accordance with Einstein's theory of relativity.

Reports from Wallal, Adelaide and Central Australia are very satisfactory, as ideal weather conditions prevailed; and results of great importance are expected. The weather at Christmas Island, however, was very cloudy so that only a corona photograph could be taken. Conditions were also not very favourable at Goondiwindi in Queensland.

The Experimental Study of the Propagation of Sound.

The Explosion of October 28th, 1922.

THE proposal by the Dutch Ministry of War to arrange an explosion in order that the propagation of sound might be studied was noted in the last number of *The Meteorological Magazine.* It was thought that, owing to some opposition from people living near the place of explosion, the experiment would have to be deferred. But the matter was arranged satisfactorily and at 17h. G.M.T. on October 28th the explosion of five tons of ammonium perchlorate took place at Oldebroek, a village in Gelderland 10 miles west-south-west of Zwolle (long. 5° 59′ 40″ E, lat. 52° 29′ 56″ N).

In this country arrangements were made by the Meteorological Office for the observers at all the observatories and reporting stations to listen for the sound and to make notes regarding the meteorological conditions at the time. Where possible, observations of wind and temperature in the upper air were also made. In addition, a note was issued to the press inviting the public to forward to the Meteorological Office any notes of observations made; some indication of the type of observation which would prove most useful was also given.

Over a hundred reports have been received up to the present. The most distant points at which the explosion is alleged to have been heard are North Wales and Northumberland. Two valuable records have been obtained on the hot wire microphones of the Signals Experimental Establishment, at Woolwich and at Biggin Hill, Kent, respectively. As soon as the British observations have been examined and summarised the results will be forwarded to the Dutch Meteorological Service for collation with Continental reports. It is hoped that some account of the results will be published in this magazine at a later date.

Daily Charts of the Northern Hemisphere.

THE reports now being received daily in this country from American stations by wireless telegraphy as noted in the July magazine enable charts of pressure and wind for a considerable portion of the Northern Hemisphere to be prepared in the Forecast Service each day. Such charts are now exhibited in a ground-floor window in the Air Ministry, Kingsway, adjoining that where the large blackboard map of weather conditions in north-west Europe is shown. The Northern Hemisphere weather charts cover an area extending roughly over the Temperate zone from the Pacific coast of America in the west to the western borders of Asia in the east.

It will be seen that, except for the absence of Siberian observations, the area covered by the new charts is practically the same as used to be shown in the *Weekly Weather Report*, Section 2.—Daily Synoptic Charts of the Greater Part of the Northern Hemisphere. Those charts were largely based on the printed reports for the same countries and appeared two weeks after date. Publication was suspended at the beginning of the war, and for reasons of economy it has not been resumed.

Meteorological Stations in the Arctic Circle.

AN interesting article on *Meteorology of To-Day* was printed in *The Times* of September 21st. It described how Professor V. Bjerknes and his collaborators are endeavouring to establish a chain of stations round the Pole in order to study the movement of the polar current and to ascertain the centres of its conflict with the opposing equatorial current. A series of stations in this region will have practical as well as theoretical significance, since regular forecasts for the North Atlantic will be required when the Transatlantic air-route is in daily use. Observations from more than one station in Spitzbergen have been available for some time; and since October, 1921, wireless weather messages have been sent out six times a day from the station at Jan Mayen, which was established after considerable difficulties by Ekerold and his party. The observations are published in the International Section of the *Daily Weather Report.* On several occasions, warnings of approaching storms sent out from Jan Mayen have averted much damage to Scandinavian shipping. Mr. Ekerold is now proposing to establish a third station on Baffin Island in Davis' Strait, near to western Greenland. It will be over a thousand miles from any existing station. Professor Bjerknes considers that a station in this position will add greatly to our knowledge of circumpolar climatology and will prove of the utmost value for Atlantic forecasts. Moreover, Dr. Nansen is of the opinion that the observations of barometric pressure on Baffin Island will be of great importance in the prediction of the Atlantic ice-drift.

It is to be hoped that Ekerold will secure sufficient support to enable him to carry out his project. His pioneer work in Jan Mayen has been of value to the weather service of this country as well as to that of Norway.

Reports from Greenland.

SINCE October 28th, reports have been received by wireless telegraphy from Mygbugten, situated on the east coast of Greenland, in latitude 73° 30′ N. These observations are due to the enterprise of the Norwegian Meteorological Service, which has taken advantage of the despatch of a hunting expedition to the eastern coast of Greenland, to set up a meteorological station in that inhospitable region. It is understood that the reports from Mygbugten are despatched by wireless to Jan Mayen and from there to Norway. They are issued in the collective message from Christiania and so are available to all European countries. The station forms a valuable addition to the existing northern network which previously consisted of Spitzbergen, Bear Island, Jan Mayen and the stations in Iceland, so that the pressure changes which occur in these northern regions between longitudes 30° E and 30° W can now be studied from day to day in considerable detail.

Instruments for the Study of Atmospheric Pollution.

A PAMPHLET bearing the title *Instruments for Measuring and Recording the Quantity of Smoke and Dust Pollution in the Atmosphere* has recently been issued by Messrs. C. F. Casella and Co. The instruments described are those designed by Dr. J. S. Owens and adopted by the Advisory Committee on Atmospheric Pollution. The Automatic Air-Filter, which serves to give a record, practically continuous, of the changes in the amount of dirt in the air, is described and illustrated, and full instructions for its manipulation are given. The ingenuity shown in this apparatus, in which the ordinary water supply is used both for pumping the air and for controlling the movement of the recording apparatus, is remarkable. Equally original ideas are incorporated in Dr. Owens's apparatus for dust examination. The use of a humidifier (a tube lined with wet blotting paper) to ensure that all the dirt particles shall act as centres of condensation is a case in point. The air is being sucked through a narrow passage so as to impinge on a glass plate (a microscope cover-glass), and it is necessary to catch all the dirt particles on the plate. There is slight cooling of the air by expansion and therefore with saturated air the particles carry moisture and stick to the plate. Casella's pamphlet contains telling reproductions of photo-micrographs obtained from Dr. Owens's records. The apparatus should prove of use in the investigation of the conditions which prevail in factories and other places where the air is impure. For the purpose for which it was designed—the investigation of the nature of the dust in the free atmosphere—it is invaluable.

Toy Balloon "Races" from Brighton.

DURING the summer months of this year toy balloon "races" were arranged at Brighton by Major J. M. MacLulish. Attached to each balloon was a numbered postcard to be returned with place and time of finding. Prizes were awarded for long distance flights and the finders were rewarded. The "races" were at first merely an amusement, but Mr. H. Harries has interested himself in the scheme and at his suggestion the dating and timing of the departure of the balloons was adopted so that an investigation of the returned cards may yield some interesting information. Several long distance flights were recorded, the longest being 460 miles; the course on that occasion was S 77° E and the balloon reached Greding, in Bavaria.

It may be noted here that all pilot balloons sent up from official meteorological stations in this country have labels attached which, it is requested, should be returned by the finders.

Obituary.

Stefan C. Hepites.—We regret to learn of the death, at Braila, on September 15th, 1922, aged 71 years, of Doctor Stefan C. Hepites, formerly Director of the Central Meteorological Institute of Roumania. Doctor Hepites was educated as an engineer and early, became interested in meteorology: in 1878 he installed a station at Braila. Owing largely to his influence, other stations began to appear, and their observations were published by the Academic Society of Roumania. In 1883 Doctor Hepites was commissioned by the Department of Home Affairs to study the organization of Meteorological Services in Europe, and his report resulted in the formation, in April, 1884, of the Central Meteorological Institute of Roumania, of which he was the first Director. Under his energetic leadership the Institute maintained an active existence, and issued, besides the *Analele* and the *Buletinul Lunar*, a number of valuable memoirs, most of which were prepared by Hepites himself. Special reference may be made to the *Album Climatologique de Roumanie* and the *Régime Pluviométrique de Roumanie,* both published in 1900. Between 1894 and 1907 appeared his *Materials for the Climatology of Roumania,* a series of twenty-five monographs. In 1895 the Roumanian Daily Weather Report made its first appearance, and in 1903 a Seismological Service was established.

Doctor Hepites resigned the active administration of the Meteorological Institute on April 14th, 1907, when he was succeeded by J. St. Murat, but he retained the title of Honorary Director. In 1908, when the Meteorological Institute was incorporated with an Astronomical Service under the title "Astronomical and Meteorological Observatory," his official connection with the service ceased, but he continued to take an active interest in the meteorological work of his native country, and in the re-organization which has been rendered necessary by the War his advice will be greatly missed.

Doctor Hepites was a member of the International Meteorological Committee from 1891 to 1908.

Reviews.

Earthquakes in Jamaica from 1688 to 1919. By MAXWELL HALL, M.A., F.R.A.S., F.R.Met.Soc., Government Meteorologist. 13 × 8, pp. 58. Illus. Jamaica: Government Printing Office, Kingston, 1922.

MODERN seismologists have shown a tendency to ignore the actual earthquake shock except as a means of setting up a variety of waves in the substance of the earth. The detection and measurement of these waves have occupied the experimentalist and their interpretation in terms of the physical properties of the earth has attracted the mathematician.

By the very remarkable facts he brings forward in his study of earthquakes in Jamaica, Mr. Maxwell Hall recalls attention to the origin of earthquakes. One half of the paper is a register of quakes felt in Jamaica from 1668 to 1919. Information has been more plentiful since 1880, when the weather service was started. It is found that of the 700 shocks recorded since 1880, all but 16 can be ascribed to 16 epicentres, distributed throughout the island (or in the adjacent seas), and that each of these epicentres has its own period. The periods for the different epicentres are from 9 to 31 days. The relation between the dates of the various shocks of a series may be stated in the form $D = E + nP$, E being the date of the first shock noted, D the date of a subsequent shock, P the period and n an integer. There are complications, however: (1) n does not increase regularly by unity; shocks may occur regularly for two or three periods and then miss a hundred. (2) The period of an epicentre may undergo a change after a shock, the series then continuing with a new period. Ten such changes of period are noted. (3) While the main series of shocks flows on regularly, two or more shocks may occur with correct intervals of nP between them, but at dates which do not agree with the primary series, so that short intervening series are found. Thirteen such short series are given.

No difference greater than two days occurs between the actual recorded time of a shock and the computed time. This means that in the longer series, where n sometimes exceeds 1,000, the period must be determined to within a few minutes!

In fifteen short and tantalising paragraphs Mr. Hall discusses these important results, sets out the earthquake frequency for each year, month and hour, makes suggestions as to the effect of meteorological elements and gives good reasons for assuming a variation in the depth of the epicentres with time. Such restraint in the presence of results which open floods of speculative thought must be admired and one can only express the deepest regret that Mr. Hall's death has forestalled the possibility of his dealing with the new material which must be produced by the application of these methods to other parts of the world, especially those where local epicentres are less numerous.

The study of this paper has brought to my notice two facts which may be worthy of mention here. Firstly, it is curious and perhaps significant that of the eight numbers represented by $9{\cdot}1 + 1{\cdot}7n$, where $n = 0, 1, 2 \ldots\ldots\ldots 7$, six are epicentre-periods. Secondly, the chance of an earthquake of any one series occurring appears to be unaffected by accidental synchronising. To test this the following table was compiled from the data in Hall's paper referring to the 700 days from June 1917 :—

Number of quakes due in one day.	Number of days.	Shocks recorded.	Ratio of shocks recorded to shocks due.
0	231	—	—
1	241	49	1·59
2	151	38	1·80
3	58	30	1·58
4	14	9	1·62
5	0	0	—
6	1	0	—

R. A. W.

Official Publication.

Meteorological Office. Geophysical Memoirs. No. 19, Hurricanes and Tropical Revolving Storms. By Mrs. E. V. Newnham, M.Sc. With an Introduction on *The Birth and Death of Cyclones.* By Sir Napier Shaw, F.R.S. Pp. viii + 122. Illus. H.M.S.O., 1922. Price 12s. 6d.

THIS memoir was written as the result of a correspondence between the Secretary of State for the Colonies and the Meteorological Office about a West Indian hurricane occurring in September, 1917, and it was decided that it was desirable to tabulate the available data relating to tropical hurricanes and to discuss the theory of their origin and maintenance. Mrs. Newnham has done her work well, and a most interesting memoir has been produced. Sir Napier Shaw has added a lecture on " The Birth and Death of Cyclones " that he delivered at Bergen on July 22nd, 1920, and some remarks by Dr. Harold Jeffreys on the theory of the subject are included in the text.

Mrs. Newnham's work cannot fail to be of use to those " that go down to the sea in ships and do business in great waters," for it will increase the precision of the rules by means of which a navigating officer is often able to steer his ship so as to escape the dangerous part of the storm. Full details are given of the usual tracks and speed of hurricanes in each of the six zones in one or other of which ninety or more per cent. of them occur.

To meteorologists who are not likely to have close personal acquaintance with these storms the interest lies in their theoretical explanation. We know fairly well the laws, dynamical and thermo-dynamical, which govern the motion of the atmosphere and it is somewhat strange that we cannot form the outline of a theory that will meet with general acceptance. Unequal heating of the earth's surface by solar radiation is undoubtedly the primary cause of all wind, but on the further details we are not agreed. The most generally accepted view seems to be that the tropical hurricanes are convectional phenomena and Sir Napier Shaw in his lecture supports this idea. He gives strong grounds for his opinion by quoting the usual lapse rate of temperature at Batavia and showing how close it is to conditions that are unstable. Dr. Harold Jeffreys seems to incline to the same view, but less definitely. Mrs. Newnham cites two competent authorities as saying that the tropical storms are shallow, S. M. Ballon giving the height as not usually exceeding 3,000 feet, and Sir J. Elliot as not exceeding 6,000 feet. This appears to be based on the fact that the storms do not seem able to cross a mountain range, but it does not seem to me valid, for equally they nearly always die out over land even though the land is flat. Also they are usually accompanied by an enormous rainfall and such a rainfall could hardly be produced in so shallow a stratum. Sir Napier takes the height to reach up to 15 kilometres. Observations on the altitude of the clouds seen from the central calm might, when it was possible to obtain them, be of use. Possibly the disturbance is much thinner in the central parts than elsewhere. I think there is some evidence that a cyclone in temperate latitudes shows the same tendency. Granting, as seems most likely, that tropical hurricanes are convectional phenomena, it does not follow that the cylcones of temperate latitudes stand on the same footing. The hurricanes are of small diameter and have practically the same conditions as to temperature and humidity all round them; the cyclones may have a diameter of a thousand miles with large differences of temperature on the polar and equatorial sides; also, in the case of the hurricanes it is the centrifugal acceleration that produces the pressure changes, whereas in the cyclones it is the geostrophic effect of the earth's rotation that is most important. The distinction is noteworthy because the one depends on the square of the velocity and the other on the simple velocity.

The distribution of temperature that prevails over a tropical hurricane is unknown and the difficulties of observation appear to be insuperable. The distribution in a European cyclone is well known and it is established beyond dispute that the troposphere is cold, the stratosphere warm, and the tropopause—the boundary between the two—lower than usual. A satisfactory theory must explain these facts. The cold troposphere seems to me to rule out convection completely as the cause of cyclones, and I look upon it as the result of the disturbance, not its cause. The warm stratosphere must be due to the descent of its air; it can hardly be ascribed to radiation because the changes occur too quickly for radiation to have time to act, even if we could find any reason for radiation warming the air over a cyclonic disturbance more than elsewhere. In the stratosphere the warmer air is found in the higher latitude, but there is no evidence to show that in the higher strata over a cyclone the air has recently come from the north; there is in fact, save near the earth's surface, no correlation between the north-to-south component of the wind and the temperature. My own belief is that the cyclones of temperate latitudes originate in the upper half of the troposphere and are due to a strengthening of the winds in that region which causes a sucking action outwards from the centre. The observed temperature distribution, with the drop of the tropopause, follows naturally in a manner I have set out* elsewhere.

W. H. DINES,

News in Brief.

The subject for the Geophysical Discussion at the Royal Astronomical Society on October 27th was on " The Maintenance of the Earth's Electric Charge." The discussion was opened by Dr. G. C. Simpson, F.R.S.

The following note appeared in the *Daily Chronicle* for September 19th :—" A bottle of rain-water was one of the thank offerings at Chingford Wesleyan Church Harvest Festival."

The *Evening Standard* of July 21st, 1922, reports that " postage stamps that change colour with the weather are worrying the French postal authorities, who have decided that hereafter the intrinsic value of a stamp will be marked plainly in figures.'

A curious accident occurred at the Waterworks at Sheering on May 1st. About 8 p.m. a brilliant flash of lightning was seen and shortly afterwards the main was found to have burst. The lightning had struck a telegraph pole (which stood about a foot from the main), travelled down the conductor and cut a piece of pipe 15 × 3 inches clean out.

The snowstorm of October 29th, 1922, over south-west England was remarkable for the time of year. At Falmouth, snow was falling from noon until 17h. It appears that in the whole history of the observatory, which has been in continuous operation since 1868, there has never before been snow in October, *i.e.*, snow as opposed to mere sleet. Sleet has been logged twice on October 12th, 1887, and on October 29th, 1895.

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* *Phil. Trans. Roy. Soc.*, Series A, Vol. 24, p. 276; and *Geophysical Memoirs*, No. 13, p. 70.

The Weather of October, 1922.

At the beginning of the month a considerable belt of high pressure extended from Madeira across France to Scandinavia. On the 5th, however, a shallow depression passed south-eastwards from Ireland to France. The belt of high pressure moved northwards, and by the 7th an anticyclone was centred over Britain. Later it moved east to Scandinavia. Little change then occurred until the 16th, when the centre moved westwards to Iceland. High pressure then persisted in this region until the end of the month, while a series of Atlantic depressions moved eastwards on a track well to the south and crossed the Iberian Peninsula to the Mediterranean. At the same time a second series moved southwards from Spitzbergen across Scandinavia to Central Europe.

Throughout Great Britain the month, as a whole, proved to be remarkably dry, and rainfall totals were in most cases considerably below normal values. The total for the month at Bidston (Liverpool) was but 7 mm., 22 mm. below the previous lowest October total and 70 mm. less than average. Falmouth was 70 mm. below normal and Ross-on-Wye 69 mm. London (Kew observations) measured only 18 mm.—a deficit of 51 mm.

Sunshine, on the other hand, was generally above average, the second week being exceedingly fine, almost continuous records being obtained at English stations on successive days.

The weather on the 1st and 2nd was mild, with south-westerly winds, maximum temperatures in England being rather above normal, while Limoges on the 1st reached 72° F., and Toulouse on the 2nd 75° F. On the third, with the passage of a depression north-eastward, rainfall in Scotland was rather heavy. Aberdeen measured 14 mm. and Castlebay 13 mm.; Limoges and Toulouse were again warm, both stations reaching 77° F. The depression by the 4th had reached the Baltic, Posen recording 17 mm. and Memel 11 mm. A second low on the 4th and 5th gave 23 mm. of rain at Plymouth, 17 mm. at Falmouth, and somewhat smaller amounts at Calais and Brussels. A rise in pressure in the north then ensued and with north-easterly winds, temperatures suffered a decrease. The highest in England on the 6th was 62° F. and readings in France fell generally below 70″ F. Gibraltar, however, on the 5th reached 80° F. At this time a vigorous "low" over the eastern Baltic gave rise to a storm during which one of two old Russian warships, while being towed to Germany, broke adrift and became a total wreck near Prangli-saar, Esthonia. Conditions in England from 7th to 9th were drier, little rain beyond east coast drizzle being reported. Further east and south, measurements were however greater, 10 mm. at Lugano (8th) and 9 mm. at Neufahrwasser during a thunderstorm. The same evening, Nice was plunged into darkness for a quarter of an hour owing to the breakdown of the electric light during a violent storm. The high pressure system to the north then moved eastwards and unsettled conditions set in in Scotland and the north-west. On the 11th 18 mm. of rain were recorded at Jan Mayen, and 13 mm. at Eskdalemuir, while the latter place on the 12th measured 22 mm. At the same time, a " low " over France and Italy gave 30 mm. at Lugano and 10 mm. at Leghorn. Maximum temperature readings in England, with almost continuous sunshine showed a steady rise during the following few days. Llandudno on the 14th reached 70° F. and Colwyn Bay 69° F. Subsequently, with the movement west of the " high," winds again became north-easterly and a decrease in temperature followed. Conditions, however, remained dry, with cloudy skies in the east. The depressions from the north gave rise to considerable rains in southern Poland, causing the flooding of the Oder at Ratiboar. Gales occurred in Norway in the strong polar current at the rear of these cyclones and low temperatures were recorded on the succeeding days. On the 21st Spitzbergen recorded 21° F. at 13h. and snow was reported from mountain stations and at Berlin. With the movement eastwards of depressions across Spain, an unsettled spell began in the Mediterranean. Gibraltar measured 26 mm. on the 22nd, and Geneva, the night following, 22 mm. Taranto experienced 75 mm. on the 25th and the Azores 66 mm.

In the north-west, minimum temperatures showed frost on several nights. On the 25th Renfrew fell to 24° F. and Eskdalemuir to 21° F.; sleet and hail made their appearance on the east coast of Britain, the same morning.

Snow and sleet occurred in the northern parts of the British Isles on the 27th and extended south the following day. London had a slight shower, and a heavy fall occurred in the south-west on the 29th, when a depression over France moving north-east gave rise to gales in the Channel. Weather then improved, the 31st being fine with normal temperatures in England; but a rapid change was occurring and by the evening a large depression off the west of Scotland was giving rise to general south-westerly winds of gale force, accompanied by almost continuous rain in the west and north.

S. F. W.

North Atlantic weather has again been very stormy, and several of the large liners were delayed in consequence. Shipping has also suffered in the bay of Biscay and off the coasts of Brittany. A French fishing boat was driven out into the Atlantic, and the crew were five days without food before being rescued.

On the 18th, the small island of Barbuda, in the West Indies, now a dependency of Antigua, was visited by a severe hurricane, described as the worst within the memory of the inhabitants. No accounts of this storm have been received from adjacent islands, and details are scanty. It is interesting to note that the maximum frequency of hurricanes in this region occurs in August and September, and that during the period 1876 to 1919 only four hurricanes originated or passed near Barbuda in the month of October. The present storm, following on that of Bermuda, described in last month's issue, seems to indicate an unusually severe season.

It was reported on the 24th that heavy rain in Tangiers had caused the collapse of walls in the native quarter of the town, with casualties. This event was probably the result of a storm, but the mean rainfall for the month is fairly heavy and is given by Hann as 91 mm. (3·6 in.).

The Indian monsoon was weak throughout October, and no cyclone occurred in the bay of Bengal. As a result of heavy rains at the end of September, it was reported on October 3rd by the Government of Bengal that the whole country from Jamalganj, in the Bhogra district, to Santahar, was flooded, houses and cattle being swept away. A later message stated that the loss of life had been relatively small, although 1,500 square miles had been inundated, and a population of a million and a half was involved. The heavy rainfall occurred round the head of the Bay of Bengal, Orissa, Chota Nagpur, and Upper Burma being also affected. A suggestion that floods are on the increase in India owing to railway embankments holding up the water has been denied.

Early in the month a typhoon in the Wenchow district of China (province of Chekiang) caused widespread damage.

Mr. R. C. Mossman reports a severe snowstorm at Puente del Inca, a station in the Andes, in latitude 33° S., at a height of 8,927 feet. The snow, which fell during a severe gale, reached a depth of 4 feet; it is the worst fall of the winter, and is unusual so late in the season. A feature of the winter and spring months (June to October) in the Argentine, has been the unusual rapidity with which cyclonic and anti-cyclonic systems have crossed the country. The Argentine forecasters consider that never since the daily weather charts were instituted in 1902 has the atmospheric circulation been so active.

The special message from Brazil states that the rainfall averaged 40 mm. below normal in the north, but 50 mm. above normal in the central districts. In the south, the rainfall was slightly below normal. Temperature was well below normal in the south and several frosts were recorded. The active circulation associated with high pressure areas, referred to in September, continued during October (see also the message from the Argentine above). On the south coast there were storms on the 6th and the 26th. Crops are generally satisfactory, except that

(*Continued on p.* 294.)

Rainfall Table for October 1922.

STATION.	COUNTY.	Aver. 1881—1915.	1922.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days.
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	2·63	1·02	26	39	·28	1	12
Tenterden (View Tower)	*Kent*	3·49	1·81	46	52	·40	4	16
Arundel (Patching Farm)	*Sussex*	3·96	·87	22	22	·55	4	6
Fordingbridge (Oaklands)	*Hampshire*	4·15	1·34	34	32	·59	4	8
Oxford (Magdalen College)	*Oxfordshire*	2·79	·56	14	20	·15	29	12
Wellingborough (Swanspool)	*Northampton*	2·52	·79	20	31	·15	31	13
Hawkedon Rectory	*Suffolk*	2·70	·64	16	24	·21	19	12
Norwich (Eaton)	*Norfolk*	3·12	1·42	36	45	·28	20	16
Launceston (Polapit Tamar)	*Devon*	4·80	1·59	40	33	·47	4	7
Sidmouth (Sidmount)	"	3·72	1·58	40	42	·78	4	8
Ross (County Observatory)	*Herefordshire*	3·28	·55	14	17	·14	31	11
Church Stretton (Wolstaston)	*Shropshire*	3·62	·94	24	26	·34	5	6
Boston (Black Sluice)	*Lincoln*	2·74	1·15	29	42	·14	18,19	19
Worksop (Hodsock Priory)	*Nottingham*	2·63	·75	19	28	·23	19	14
Mickleover (Clyde House)	*Derbyshire*	2·69	·58	15	22	·17	31	12
Southport (Hesketh Park)	*Lancashire*	3·54	·58	15	16	·30	31	6
Wetherby (Ribston Hall)	*York, W. R.*	3·00	1·08	27	36	·24	31	7
Hull (Pearson Park)	" *E. R.*	2·98	2·36	60	79	1·13	5	24
Newcastle (Town Moor)	*North'land*	3·20	1·90	48	59	·36	30	11
Borrowdale (Seathwaite)	*Cumberland*	12·00	4·50	114	38	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	4·80	1·73	44	36	·70	31	8
Haverfordwest (Gram. Sch.)	*Pembroke*	5·41	1·41	36	26	1·01	31	5
Aberystwyth (Gogerddan)	*Cardigan*	5·28	·79	20	15	·69	31	2
Llandudno	*Carnarvon*	3·59	·31	8	9	·11	31	7
Dumfries (Cargen)	*Kirkcudbrt.*	4·36	2·38	61	55	·92	31	10
Marchmont House	*Berwick*	3·82	3·44	87	90	·58	5	24
Girvan (Pinmore)	*Ayr*	5·00	1·99	51	40	·46	31	10
Glasgow (Queen's Park)	*Renfrew*	3·25	1·92	49	59	·62	31	9
Islay (Eallabus)	*Argyll*	4·77	2·55	65	53	·66	3	10
Mull (Quinish)	"	5·60	3·77	96	67	·82	3	11
Loch Dhu	*Perth*	7·15	4·50	114	63	1·05	31	8
Dundee (Eastern Necropolis)	*Forfar*	2·66	1·52	39	57	·50	3	14
Braemar (Bank)	*Aberdeen*	3·76	1·56	40	41	·51	3	8
Aberdeen (Cranford)	"	3·25	2·84	72	87	·60	30	23
Gordon Castle	*Moray*	3·16	1·34	34	42	·49	3	15
Fort William (Atholl Bank)	*Inverness*	7·14	4·92	125	69	2·30	31	12
Alness (Ardross Castle)	*Ross*	3·85	2·72	69	71	1·81	31	12
Loch Torridon (Bendamph)	"	8·02	3·35	85	42	1·37	31	11
Stornoway	"	5·18	3·30	84	64	·64	13	19
Loch More (Achfary)	*Sutherland*	7·80	3·98	101	51	·85	13	19
Wick	*Caithness*	2·96	1·53	39	52	·22	31	17
Glanmire (Lota Lodge)	*Cork*	4·15	1·81	46	44	·66	31	10
Killarney (District Asylum)	*Kerry*	5·37	..	..	..	..	..	..
Waterford (Brook Lodge)	*Waterford*	3·91	1·20	31	31	·55	31	8
Nenagh (Castle Lough)	*Tipperary*	3·39	1·07	27	32	·61	31	6
Foynes	*Limerick*	3·71	·60	15	16	·26	31	7
Gorey (Courtown House)	*Wexford*	3·54	1·07	27	30	·40	31	10
Abbey Leix (Blandsfort)	*Queen's Co.*	3·52	1·01	26	29	·34	31	10
Dublin (FitzWilliam Square)	*Dublin*	2·68	·86	22	32	·14	5	14
Mullingar (Belvedere)	*Westmeath*	3·12	..	..	..	..	..	..
Crossmolina (Enniscoe)	*Mayo*	5·18	..	..	..	..	..	..
Collooney (Markree Obsy.)	*Sligo*	4·11	1·93	49	47	·80	11	9
Seaforde	*Down*	3·56	1·73	44	49	·64	11	9
Ballymena (Harryville)	*Antrim*	3·69	1·77	45	48	·64	11	11
Omagh (Edenfel)	*Tyrone*	3·67	2·01	51	55	·81	11	11
Letterkenny Asylum	*Donegal*	4·20	1·29	33	31	·30	11,31	12

Supplementary Rainfall, October 1922.

Div.	STATION.	RAIN.	
		in.	mm.
II.	Ramsgate	2·78	71
,,	Sevenoaks, Speldhurst	1·43	36
,,	Hailsham Vicarage	1·15	29
,,	Totland Bay, Aston Ho.	1·22	31
,,	Ashley, Old Manor Ho.	..	..
,,	Grayshott	1·14	29
,,	Ufton Nervet	·84	21
III.	Harrow Weald, Hill Ho.	·83	21
,,	Pitsford, Sedgebrook	·69	17
,,	Chatteris, The Priory	·44	11
IV.	Elsenham, Gaunts End	·60	15
,,	Lexden, Hill House	·85	22
,,	Aylsham, Rippon Hall	1·51	38
,,	Swaffham	·70	18
V.	Devizes, Highclere	1·28	33
,,	Weymouth	1·77	45
,,	Ashburton, Druid Ho.	2·01	51
,,	Cullompton	1·25	32
,,	Hartland Abbey	1·64	42
,,	Penzance, Morrab Gden.	2·38	60
,,	St. Austell, Trevarna	1·52	39
,,	Crewkerne Merefield Ho	1·71	43
VI.	Clifton College	1·46	37
,,	Ledbury, Underdown	·43	11
,,	Shifnal, Hatton Grange	·61	15
,,	Ashbourne, Mayfield	·53	13
,,	Barnt Green, Upwood	·32	8
,,	Blockley, Upton Wold	·61	15
VII.	Leicester, Town Hall Sq	·61	15
,,	Grantham, Saltersford	1·58	40
,,	Louth, Westgate	1·77	45
,,	Mansfield, West Bank	1·06	27
VIII.	Nantwich, Dorfold Hall	·44	11
,,	Bolton, Queen's Park	·58	15
,,	Lancaster, Strathspey	·90	23
IX.	Wath-upon-Dearne	·98	25
,,	Bradford, Lister Park	·88	22
,,	West Witton	1·22	31
,,	Scarborough, Scalby	1·88	48
,,	Middlesbro', Albert Pk.	1·42	36
,,	Mickleton	..	..
X.	Bellingham	1·54	39
,,	Ilderton, Lilburn	2·88	73
,,	Orton	2·40	61
XI.	Llanfrechfa Grange	1·85	47
,,	Treherbert, Tyn-y-waun	3·06	78
,,	Carmarthen Friary	1·65	42
,,	Lampeter, Falcondale	1·33	34
,,	Cray Station	2·80	71
,,	B'ham W.W., Tyrmyndd	1·74	44
,,	Lake Vyrnwy	2·24	57
,,	Llangynhafal, P. Drâw	·66	17
,,	Oakley Quarries	1·40	36
,,	Dolgelly, Bryntirion	1·69	43
,,	Snowdon L., Llydaw 9	6·55	166
,,	Lligwy	·88	22
XII.	Stoneykirk, Ardwell Ho	2·20	56
,,	Carsphairn, Shiel	4·03	102
XII.	Langholm, Drove Rd.	2·98	76
XIII.	Ettrick Manse	3·96	101
,,	North Berwick Res.	1·95	49
,,	Edinburgh, Royal Ob.	1·67	43
XIV.	Biggar	1·90	48
,,	Leadhills	4·11	104
,,	Kilmarnock, Agric. Coll.	2·59	66
XV.	Dougarie Lodge	2·81	71
,,	Oban	3·76	95
,,	Holy Loch, Ardnadam	..	..
,,	Tiree, Cornaigmore	..	..
XVI.	Loch Venachar	3·40	86
,,	Glenquey Reservoir	3·60	91
,,	Loch Rannoch, Dall	2·02	51
,,	Blair Castle Gardens	1·15	29
,,	Coupar Angus	1·39	35
,,	Montrose Asylum	1·42	36
XVII.	Logie Coldstone, School	1·52	39
,,	Fyvie Castle	2·16	55
,,	Grantown-on-Spey	2·06	52
XVIII.	Kingussie, Fasnakyle	1·78	45
,,	Fort Augustus	2·71	69
,,	Loch Quoich, Loan	6·90	175
,,	Fortrose	1·51	38
,,	Faire-na-Squir	3·76	95
,,	Skye, Dunvegan	3·74	95
XIX.	Loch Carron, Plockton	2·64	67
,,	Dornoch, St. Gilbert's	·96	24
,,	Tongue Manse	2·39	61
,,	Melvich Schoolhouse	1·33	34
XX.	Dunmanway Rectory	3·07	78
,,	Mitchelstown Castle	..	..
,,	Gearahameen	1·00	25
,,	Darrynane Abbey	..	..
,,	Cashel, Ballinamona	1·26	32
,,	Roscrea, Timoney Park	·82	21
,,	Broadford, Hurdlestown	1·31	33
XXI.	Kilkenny Castle	·86	22
,,	Rathnew, Clonmannon	1·21	31
,,	Hacketstown Rectory	1·29	33
,,	Balbriggan, Ardgillan	1·28	33
,,	Drogheda	1·41	36
,,	Athlone, Twyford	..	..
XXII.	Castle Forbes Gdns.	1·65	42
,,	Ballynahinch Castle	..	..
,,	Galway, Grammar Sch.	1·37	35
XXIII.	Westport House	1·83	47
,,	Enniskillen, Portora	1·41	36
,,	Crossdoney, Kevit Cas.	1·78	45
,,	Armagh Observatory	1·27	32
,,	Warrenpoint	1·97	50
,,	Belfast, Cave Hill Rd.	1·97	50
,,	Glenarm Castle	1·36	35
,,	Londonderry, Creggan	1·40	36
,,	Sion Mills	1·64	42
,,	Milford, The Manse	1·52	39
,,	Narin, Kiltoorish	2·79	71
,,	Killybegs, Rockmount	2·37	60

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L. mb.	Diff. from Normal mb.	Max. ° F.	Date	Min. ° F.	Date	Max. ° F.	Min. ° F.	½ max. and min. ° F.	Diff. from Normal ° F.
London, Kew Observatory	1020·0	+4·1	87	24	35	13	68·0	47·2	57·6	+4·2
Gibraltar	1017·1	+2·2	80	27	48	1	72·3	59·5	65·9	+0·3
Malta	1018·2	+4·5	80	27	52	4	71·7	61·5	66·6	+1·5
Sierra Leone	1012·2	+0·5	91	4,14,30	71	8,23,27	88·2	74·6	81·4	−0·6
Lagos, Nigeria	1010·2	−0·8	91	3	71	15	87·7	75·6	81·7	+0·5
Kaduna, Nigeria	1012·3	−0·8	96	4, 15	65	25, 27, 31	90·2	70·5	80·3	+1·2
Zomba, Nyasaland	1015·6	+1·3	88	1	49	25	73·8	58·9	66·3	+0·6
Salisbury, Rhodesia	1015·4	−2·7	83	12, 16	42	23	75·8	49·2	62·5	+2·0
Cape Town	1019·9	+2·0	89	7	41	16	70·1	50·5	60·3	+1·7
Johannesburg	1021·6	+0·9	69	27	31	15	63·3	42·7	53·0	−1·4
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	..	..	73	24	23	17	65·7	36·9	51·3	−1·4
Calcutta, Alipore Obsy.	1003·6	+0·1	102	25	71	3, 8	97·1	78·7	87·9	+1·9
Bombay	1007·1	−0·6	94	1	78	9	92·1	81·3	86·7	+1·0
Madras	1005·7	+0·3	110	4	74	31	99·0	80·8	89·9	0·0
Colombo, Ceylon	1009·7	+1·5	91	5	70	9	87·6	76·8	82·2	−0·6
Hong Kong	1008·3	−1·1	89	30	71	4	83·3	75·4	79·3	+1·9
Sandakan	..	..	91	12, 14	74	8,21,31	88·5	76·1	82·3	−0·3
Sydney	1019·3	+0·7	75	4	47	28	67·1	53·2	60·1	+1·5
Melbourne	1020·3	+0·8	78	1	35	29	61·8	47·4	54·6	+0·5
Adelaide	1020·8	+0·7	79	1	41	29	65·8	51·2	58·5	+0·7
Perth, Western Australia	1019·6	+0·8	79	11	43	22	68·7	50·5	59·6	−0·8
Coolgardie	1020·1	+0·3	81	12	34	25	67·6	45·3	56·5	−1·1
Brisbane	1017·0	−1·8	87	5	47	28	75·2	55·9	65·5	+1·1
Hobart, Tasmania	1017·7	+2·1	70	1	38	27	59·0	45·3	52·1	+1·7
Wellington, N.Z.	1020·1	+4·9	66	13	32	31	59·7	45·2	52·5	−0·3
Suva, Fiji	1012·1	−0·7	86	27	60	4	82·1	67·0	74·5	−2·0
Kingston, Jamaica	1013·0	−0·3	91	6	70	3	88·1	72·9	80·5	+0·8
Grenada, W.I.	1014·4	+1·8	86	8, 9, 18	72	1	84·1	74·2	79·1	−0·4
Toronto	1015·3	+0·5	80	31	35	1	70·5	48·8	59·7	+7·0
Winnipeg	1011·9	−2·4	83	26, 27	33	30	71·7	48·4	60·1	+8·5
St. John, N.B.	1015·3	+1·3	75	29	33	1, 5	58·5	41·3	49·9	+2·2
Victoria, B.C.	1018·8	+2·4	84	31	35	9	60·8	45·4	53·1	0·0

London, Kew Observatory.—Prevailing wind direction south-westerly, mean speed 6·9 mi/hr, 2 days with hail, 3 days with thunder heard.

Gibraltar.—Prevailing wind direction E, 1 day with hail, 1 day with fog, 1 day with gale.

Malta.—Prevailing wind direction north-westerly, 1 day with hail, 2 days with thunder heard.

Sierra Leone.—Calms predominate. 8 days with tornado, 4 days with thunder heard.

Lagos.—Prevailing wind direction S.W.

Salisbury, Rhodesia.—Prevailing wind direction easterly, 2 days with thunder heard.

Lagos, Nigeria :—										
Feb. 1922 -	1008·6	−1·5	91	16	74	2, 22	88·9	77·5	83·2	+1·1
Mar. 1922 - -	1008·5	−0·9	92	13	72	22	90·0	78·5	84·3	+1·4
Kaduna, Nigeria										
Jan. 1922 - -	1014·2	+2·6	93	8	56	13, 25	88·3	60·2	74·3	0·0

Lagos.—From April the hours of observation change from 9 h. to 9h. 45 m. and 15 h. 45 m. Prevailing wind direction : Feb. westerly, Mar. westerly.

British Empire, May 1922.

TEMPERATURE				PRECIPITATION				BRIGHT SUNSHINE		STATIONS
Mean	Absolute	Relative Humidity	Mean Cloud Am'nt	Amount		Diff. from Normal	Days	Hours per day	Percentage of possible	
Wet Bulb.	Min. on Grass									
° F.	° F.	%	0–10	in.	mm.	mm.				
53·4	24	63	4·4	1·02	26	− 18	7	9·4	60	London, Kew Observatory.
59·4	45	71	4·4	0·45	11	− 34	4	..	..	Gibraltar.
60·2	48	69	3·3	0·37	9	− 1	2	10·0	71	Malta.
75·9	..	72	5·3	3·82	97	−186	16	..	..	Sierra Leone.
77·9	69	77	7·9	8·13	207	− 56	18	..	..	Lagos, Nigeria.
71·2	..	69	1·0	4·06	103	− 83	9	..	..	Kaduna, Nigeria.
..	..	80	4·8	0·68	17	− 8	9	..	..	Zomba, Nyasaland.
54·3	..	56	3·0	0·90	23	+ 11	4	..	..	Salisbury, Rhodesia.
54·5	..	64	3·7	1·71	43	− 58	9	..	..	Cape Town.
42·6	30	58	4·6	0·94	24	+ 6	3	8·5	79	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
40·3	..	56	1·2	0·80	20	− 10	2	..	..	Bloemfontein.
80·4	68	53	2·8	2·47	63	− 83	5*	..	..	Calcutta, Alipore Obsy.
78·4	68	66	2·3	0·00	0	− 18	0*	..	..	Bombay.
78·3	73	61	3·6	1·18	30	+ 3	4*	..	..	Madras.
78·4	70	73	8·2	22·66	576	+265	26	..	..	Colombo, Ceylon.
75·2	..	85	7·9	5·50	140	−157	21	5·7	43	Hong Kong.
77·9	..	83	..	7·11	181	+ 29	6	..	..	Sandakan.
55·8	39	71	5·7	3·69	94	− 38	14	4·4	42	Sydney.
51·7	35	76	6·2	2·69	68	+ 13	14	..	..	Melbourne.
53·5	33	71	6·6	3·36	85	+ 16	18	3·9	38	Adelaide.
54·7	34	66	4·2	6·37	162	+ 43	13	6·9	66	Perth, Western Australia.
51·8	31	52	3·9	0·77	20	− 15	6	..	..	Coolgardie.
60·3	42	63	3·5	2·04	52	− 23	10	..	..	Brisbane.
48·2	34	76	6·2	0·62	16	− 31	12	4·8	49	Hobart, Tasmania.
49·1	20	79	6·4	1·23	31	− 89	12	3·9	40	Wellington, N.Z.
73·5	..	87	6·4	8·42	214	− 44	18	..	..	Suva, Fiji.
..	..	73	5·9	0·28	7	−103	5	..	..	Kingston, Jamaica.
73·7	..	75	4·9	1·29	33	− 85	17	..	..	Grenada, W.I.
52·6	29	67	4·4	1·46	37	− 39	9	..	..	Toronto.
54·8	..	70	4·2	2·65	67	+ 10	12	..	..	Winnipeg.
44·7	31	73	5·6	2·63	67	− 27	11	..	..	St. John, N.B.
47·1	27	70	5·2	0·49	12	− 21	8	..	..	Victoria, B.C.

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

COLOMBO, CEYLON.—Prevailing wind direction SW, mean speed 5·9 mi/hr. 8 days with thunder heard.

HONG KONG.—Prevailing wind direction ESE, mean speed 12·4 mi/hr, 8 days with thunder heard.

SANDAKAN.—Prevailing wind direction NE.

PERTH, W.A.—Mean speed of wind 9·0 mi/hr.

WELLINGTON, N.Z.—Wind direction variable, 1 day with fog.

SUVA, FIJI.—Wind direction variable.

GRENADA.—Prevailing wind direction E., 1 day with thunder heard.

										LAGOS, NIGERIA :—
76·6	..	84	8·8	0·81	21	− 30	2	..	..	Feb. 1922.
78·1	..	80	8·9	1·50	38	− 58	7	..	..	Mar. 1922.
										KADUNA, NIGERIA :—
61·5	..	62	1·0	0·00	0	0	0	..	..	Jan. 1922.

KADUNA.—Records for February and March unreliable.

(*Continued from p.* 289.)

in the south vines were killed by the late frosts. At Rio de Janeiro, pressure during October was equal to the average but temperature was about 1° F. below normal.

Rainfall in the British Isles.

The rainfall of the month was practically everywhere below the average, an extremely rare occurrence in the British Isles. The deficiency was most marked in the centre of England and Wales, where less than a quarter of the average was recorded over a very large area. Less than a quarter of the average fell in places on the west coast of Ireland. As little as 10 per cent. of the average was recorded in the Cheshire plain, where, at Wallasey, only ·025 in. (0·6 mm.) was recorded from the 6th to 30th, a period of 25 days. In England, Wales and Ireland only small areas had rainfall above half the average. These areas included the east of Kent, where slightly more than the average was recorded locally, the extreme north-east of England and part of the north of Ireland. By far the greater part of the centre and east of Scotland had more than half the average. On parts of the east coast more than 75 per cent. of the average was recorded.

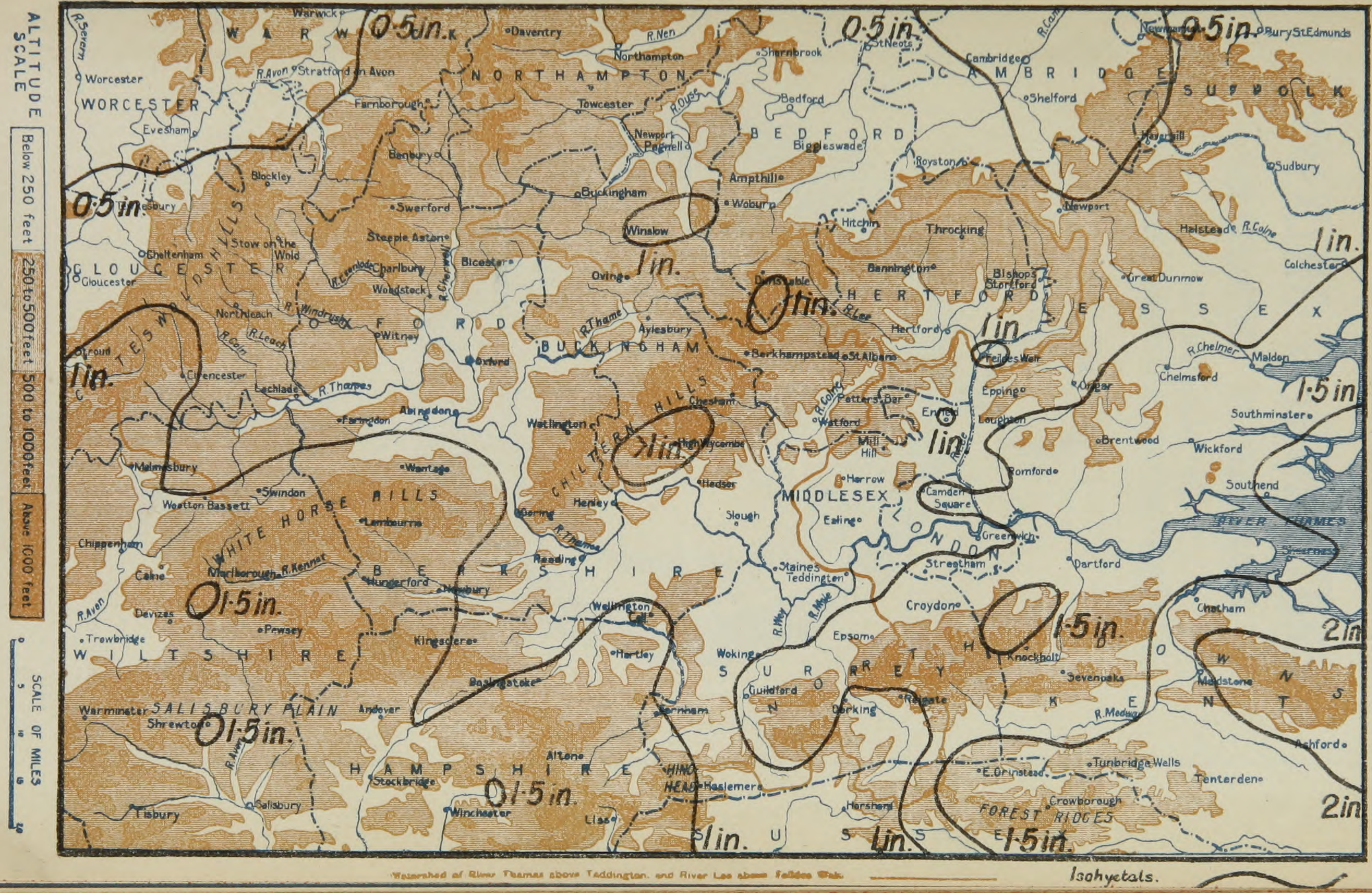
Areas with a total rainfall of less than 25 mm. (1 in.) were unusually widespread, including a large portion of the centre of England, stretching from Worthing in the south to Lancaster and York in the north, and from the Welsh border in the west to Ipswich and the Wash in the east. Less than 25 mm. also occurred in the neighbourhood of Dublin and in parts of the southern centre of Ireland. Totals of more than 75 mm. (3 in.) were much less widespread than usual, being, as a rule, local and confined to the high lands of England and Wales, and the west and south-west of Ireland. In Scotland falls of 75 mm. or more fell generally in the west.

The driest Octobers since 1865 were those of 1879, 1888, 1897 and 1904. In the two driest Octobers on record, in 1879 and 1904, the heaviest rainfall relative to the average fell in the north-west, but in 1922 the heaviest rain fell in east and centre of Scotland and along the east coast generally. So far as it is possible to see at present, October, 1922, was probably as dry over the country as a whole as any October of which we have any record.

The general rainfall, expressed as a percentage of the average, was: England and Wales, 33; Scotland, 59; Ireland, 37; British Isles, 42.

In London, Camden Square, the mean temperature for October was 48·1° F., or 2·1° F. below the average. Duration of rainfall, 21·3 hours. Evaporation, 0·66 inch.

THAMES VALLEY RAINFALL —— OCTOBER, 1922.


ALTITUDE SCALE
Below 250 feet
250 to 500 feet
500 to 1000 feet
Above 1000 feet
SCALE OF MILES
0
5
10
15
20
Watershed of River Thames above Teddington, and River Lea above Feildes Weir.
Isohyetals.
0·5 in.
1 in.
1·5 in.
2 in.
>1 in.
WARWICK
WORCESTER
NORTHAMPTON
CAMBRIDGE
SUFFOLK
BEDFORD
GLOUCESTER
OXFORD
BUCKINGHAM
HERTFORD
ESSEX
MIDDLESEX
LONDON
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WILTSHIRE
HAMPSHIRE
SURREY
KENT
SUSSEX
COTSWOLD HILLS
CHILTERN HILLS
WHITE HORSE HILLS
SALISBURY PLAIN
NORTH DOWNS
FOREST RIDGES
HIND HEAD
RIVER THAMES
R. Severn
R. Avon
R. Nen
R. Ouse
R. Cam
R. Colne
R. Chelmer
R. Cherwell
R. Evenlode
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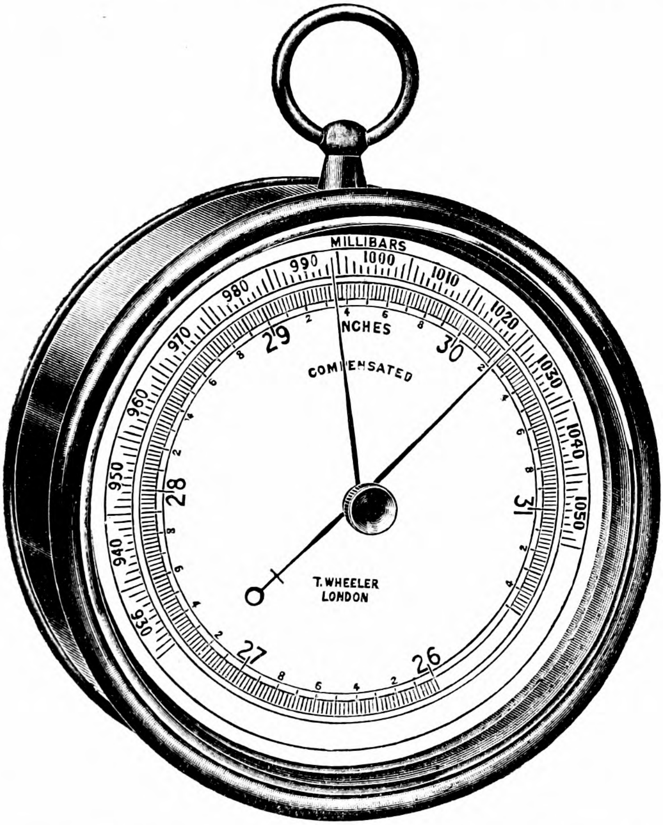

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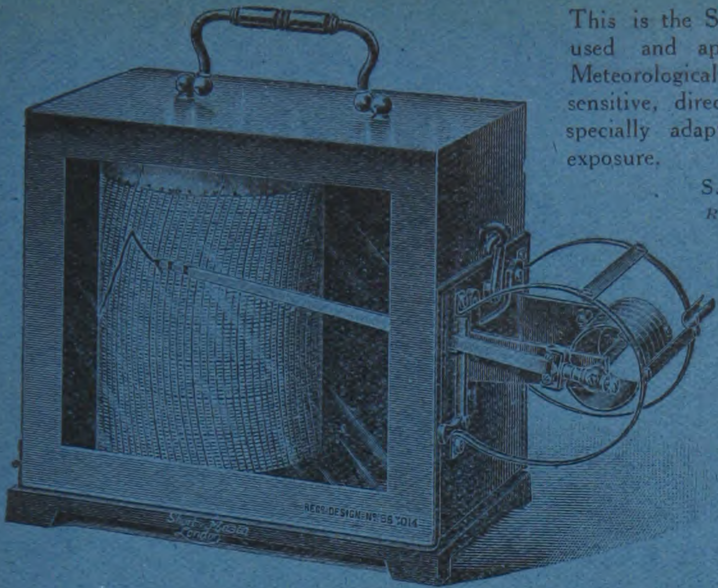

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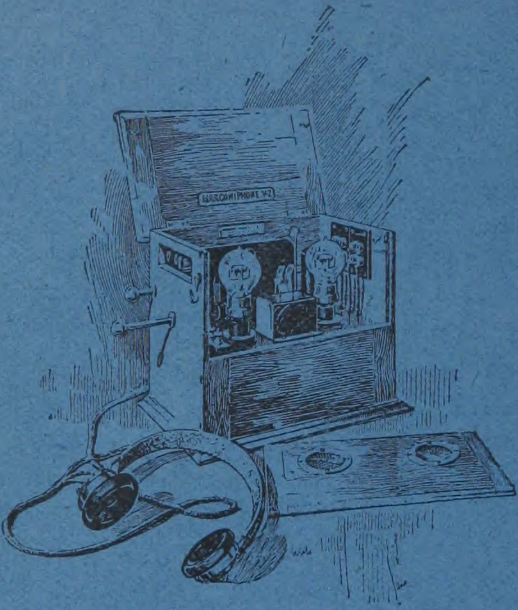

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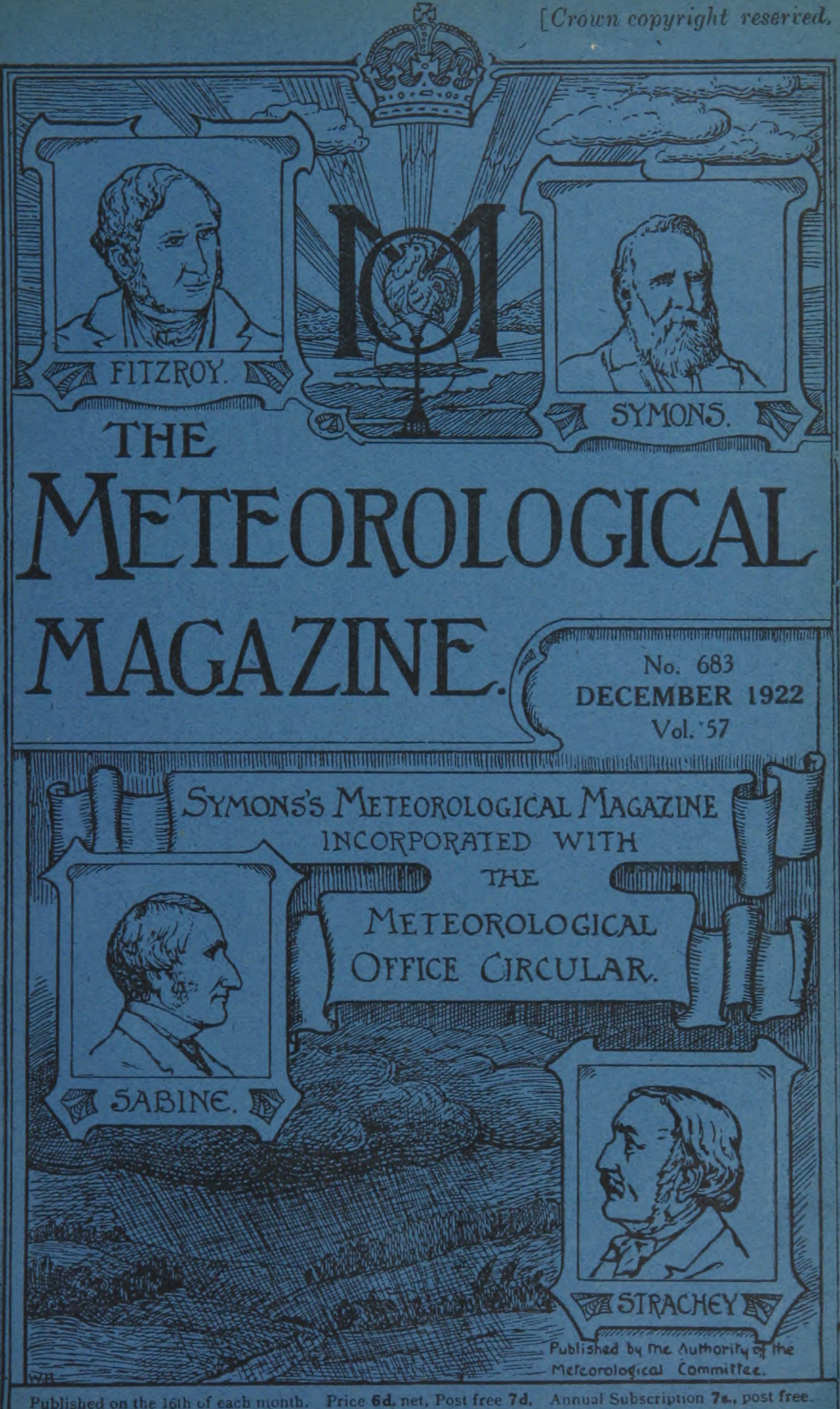

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DECEMBER, 1922.

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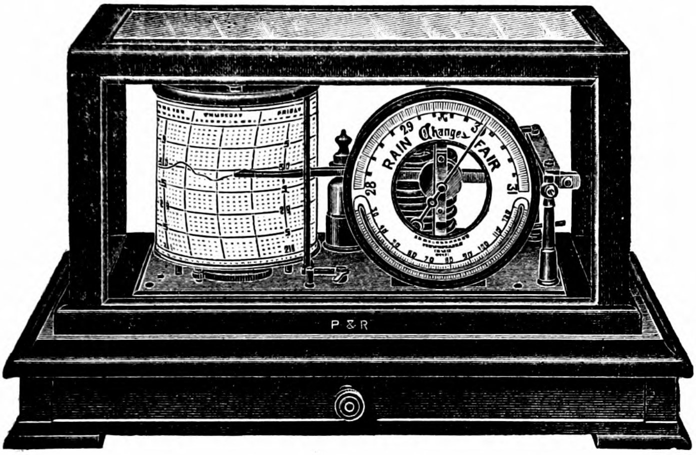

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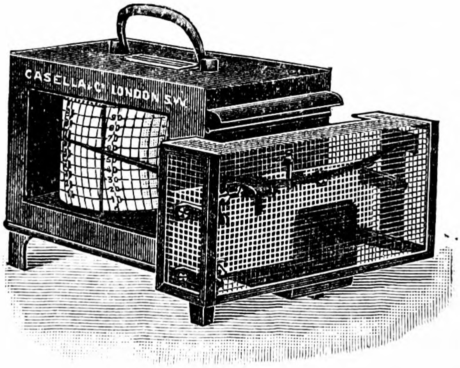

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The Evolution of Climate: A Review.

BY HUGH ROBERT MILL, D.SC.

GEOLOGISTS have earned the reputation of being a speculative and controversial folk, and in no department of their activity have speculation and controversy run riot so furiously as in the consideration of the climate of byegone times. Few investigators would dare to face the prodigious literature which has accumulated on the subject and one's first thought on opening this book is one of admiration of Mr. Brooks's courage in tackling his task. I doubt if there is such a quaking bog of contradictory and ill-arranged data slithering about under so dense a gloom of ignorance and prejudice as in the records of research into the Glacial Period which form the bulk of Mr. Brooks's study; but he seems to have found a way across it, and is able to shed most interesting light upon his subject.

No doubt Mr. Brooks adopted the best arrangement when he began his discussion of past climate with the oldest geological epoch, then went on to his main theme, the Glacial Period, and finally treated of pre-historic and historic times. Yet, in some ways, it might appear more logical to approach the past from the present, and so gradually acquire familiarity with the methods of inferring changes of climate from archæological and geological observations, before entering on the interpretation of the bewildering records of the oldest rocks.

Mr. Brooks is perhaps too modest in not accentuating the

The Evolution of Climate. By C. E. P. Brooks, M.Sc., F.R.A.I., F.R. Met. Soc. With a Preface by G. C. Simpson, D.Sc., F.R.S. 8½ × 5½, pp. 174. London: Benn Brothers, Ltd, 1922. 8*s.* 6*d.* net.

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additions to the general sum of knowledge made by his own method of calculating climatic changes from changes in elevation and in the distribution of land and water. He gives so much credit to the work of others that every reader may not appreciate how much original work this little book contains. This defect is in large measure made good by Dr. Simpson's sympathetic preface, which deserves to be read with close attention. The student who wishes to go further is helped by a carefully selected bibliography to each chapter. This shows an admirable restraint, for the temptation must have been great to cite a much larger number of authorities. I should have liked to see a reference to the useful pioneer work of Mr. F. W. Harmer, whose method of preparing isobaric charts of Tertiary Climate, described at the Bradford meeting of the British Association in 1900, induced this magazine to refer to his discovery of "fossil cyclones." Mr. Brooks makes excellent use of a similar method, and carries it far, considering the very contracted space to which he confines himself.

The plan of the book is thus indicated in the Introduction.

"Chapter I. deals generally with the causes of climatic fluctuations and with the meteorology of an Ice Age. Chapter II. gives a brief account of the climatic record as a whole, and Chapter III. deals with the Tertiary Period considered as leading up to the Quaternary Ice Age. Chapter IV. discusses the subdivisions of the Glacial period, and the conflict between advocates of one and of repeated glaciations. Chapters V. to XII. give brief accounts *from the standpoint of a meteorologist* of the glacial history of Northern Europe, the Mediterranean Region, Asia, North and South America, Africa, Australia and the South Polar Regions. In Chapters XIII. to XV. post-Glacial climatology is considered. Chapters XVI. and XVII. deal with the major climatic fluctuations of the "historic" period and finally in Chapters XVIII. and XIX. is a short discussion of the influence of climate on the evolution and history of man."

It is impossible as yet to make much of the earlier ice-ages, beyond the fact that they occurred and passed away. The causes, whether astronomical or geographical, were probably the same as those which were at work in the Glacial Period of the Quaternary, a consideration of which fills a good half of the book. Mr. Brooks lays less stress on astronomical causes than on physical changes in the crust of the Earth as instrumental in starting an ice-age. He shows how the great mountain ranges which were formed at the close of the Tertiary Period, led to changes of climate through the lowering of air-temperature and the increased precipitation of snow on the mountain summits, the area of the snow-field tended to increase and to induce the formation of a glacial anticyclone and so drive the tracks of depressions into new positions, thus completely altering the climate of large areas. On the other hand, the subsidence of an area of high land brings it below the snow-line, and ice-fields which had been formed would rapidly diminish, and with the dissipation of the glacial anticyclone the storm tracks would readjust themselves and change the climate of a very wide area.

Forty years ago geologists were fighting for the unity of the Great Ice Age, and resenting the revolutionary ideas of Prof. James Geikie and his school, who laid great stress on the thin peat-beds which were found buried in boulder clay as evidence of a genial period alternating with a glacial. Now the existence of several inter-glacial periods is recognised in most parts of the world and Mr. Brooks traces them out for each of the continents and, by his new method, even attempts to evaluate the changes of temperature they represent. It is impossible to make these chapters entertaining reading, for there is little to distinguish one glacial phase from another until in the later stages the migrations of animals and plants can be traced in relation to them. When the patient reader works through the chapters on the Ice Age he meets his reward in a fascinating presentation of the effects of climatic changes in the Human Period and here Mr. Brooks is at his best. Drawing his data from the work of anthropologists and archæologists on the one side and that of Mr. Ellsworth Huntington on tree-growth and of Prof. Otto Pettersson on marine temperatures and long lunar periods on the other, Mr. Brooks tells how the greatest climatic changes corresponded with, and were probably the cause of, the most important migrations of races. He shows how when the great civilisations of Egypt, Mesopotamia and Central Asia were at their height the climate of Europe was still dictated by the retreating polar and alpine ice-caps and unfit to support a highly civilised community; but that, as the climate of Europe improved, that of Asia began to suffer from chronic drought, the precursor of dessication and so the inhabitants were driven forth as hordes to people western Europe, now ready to receive them. This invasion took place in pulses when the drought was severe, separated by pauses when for a few generations its rigour relaxed, and thus our modern political geography and the unsolved Eastern and Near Eastern " Questions " are reducible to functions of climatic change.

Such an outlook on history gives a new depth and dignity to the study of meteorology, a new incentive to its students. A large part of what Mr. Brooks sets out will no doubt be controverted and some of it, perhaps, disproved; but he has blazed a trail into an almost unknown territory where much will yet be discovered to elucidate the past, and if we are sufficiently intelligent to profit by it, to help in the solution of practical problems of the present and future.

The Dynamics of the Circular Vortex.

Note on the Recent Work of Prof. V. Bjerknes.

By Sir Napier Shaw, F.R.S.

THIS paper* is the considered expression of Professor Bjerknes's mental picture of the dynamics of the earth's atmosphere which was sketched in lectures at the conference† between British and Norwegian meteorologists at Bergen in 1920.

We are invited to regard the general circulation of the atmosphere as a circumpolar vortex, and cyclonic depressions as examples of vortices, provisionally circular, developed out of wave motion in the polar front.

The general method of the paper is to study the dynamical conditions of a circular vortex, first in a homogeneous medium when the conditions are called barotropic; secondly, when there is a surface of discontinuity between two media each of which is homogeneous and therefore barotropic in itself but is baroclinic at or across the surface of discontinuity. For liquids, homogeneous means of equal density; for gases, of equal potential temperature.

In the analysis, *the properties* are expressed by pressure and density (or its reciprocal specific volume), and the *dynamics* by the relative positions of the surfaces of equal pressure, isobaric surfaces, and equal density, equi-substantial surfaces. If these are coincident the field is barotropic and if they cut one another it is baroclinic.

When the field is barotropic we have the conditions assumed in the classical hydrodynamics which prohibit the formation of vortices except at the boundaries. When the field is baroclinic the formation of a vortex is the natural expression of the distribution of forces.

Having made out, on these principles, the general distribution of temperature in the free atmosphere, in cyclones and anticyclones; and having connected vortices with initial wave motion in a surface of discontinuity, Professor Bjerknes points out the similarity between the results of these ideas and the results of well-known observations of the free air and the life cycle of cyclones as set out by J. Bjerknes.

We may summarize the results of the seven chapters of the paper as follows: (1) the examination of wave motion in relation to vortex motion gives a suggestion of the origin of vortices in the atmosphere apart from the general circumpolar vortex. (2) The theory of the steady circular vortex with an assumed law of velocity in a medium separated into two parts by a discontinuity is developed so far as to determine the angles between the controlling force, the isobaric surfaces, the "equi-substantial" surfaces and the surface of discontinuity. (3) The application of the theory to the atmosphere with the discontinuity of the tropopause gives the relation of change of temperature to change of wind velocity at that discontinuity. These three propositions account for the general lines of distribution of temperature in the atmosphere regarded as a vortex about the polar axis, and the distribution of temperature in cyclones and anticyclones. (4) A cyclone is treated as a vortex with maximum spin in middle height and diminished spin at top and bottom, an anticyclone as a vortex with maximum spin at top and bottom and minimum spin in the middle; hence "pumping" in the middle of a cyclone and at top and bottom of an anticyclone. Whether the "pumping" has produced the velocity or velocity lost has expressed itself as "pumping" is not clearly stated.

---

* *On the dynamics of the circular vortex with applications to the atmosphere and atmospheric vortex and wave motions.* By V. Bjerknes. *Geofysiske Publikationer,* Vol. II., No. 4. Kristiania, 1921. [Subject for discussion at the Meteorological Office, October 16th, 1922.]

† See *The Met. Mag.*, 1920, p. 166.

The question of the rapid fall of temperature in the troposphere is not treated. Convection is excluded from consideration; motion is two-dimensional.

Attention is paid only to certain recognized discontinuities, viz., the tropopause, the polar front and, by way of suggestion, the trade wind lid. But in fact, with the definition of discontinuity that is adopted, there must be many others. Discontinuity as defined is not essentially different from a condition of stability; the atmosphere being stable may, therefore, be regarded as being generally separable into discontinuous layers according to its potential temperature and all physical action in the atmosphere of the nature of convection must have discontinuity associated with it. The atmosphere is therefore liable to the formation of vortices at all levels and in many circumstances and we ought not to be surprised at finding expressions of vortex motion of many kinds throughout the range of the atmosphere.

Official Publications.

British Rainfall, 1921. 9 × 6, pp. xxviii. + 324, 3 plates. Fully illustrated. Price 12s. 6d. net.

THIS volume is the sixty-first of the series issued by the British Rainfall Organization, the third published under the authority of the Meteorological Committee and the first since the removal of the headquarters from Camden Square to South Kensington.

The year under review was in some respects the most remarkable yet discussed, being notable for the occurrence of the most widespread and severe drought since rainfall data for the British Isles first became available. Nearly the whole of the country south-east of a line drawn from Yarmouth to Plymouth, as well as part of the east of Scotland, in all about 18,000 square miles, experienced a total rainfall more than 40 per cent. below the average of 35 years; whilst more than 700 square miles, chiefly in Kent, had a deficiency of more than 50 per cent. Deficiencies of 40 per cent. in the rainfall of a calendar year are not unprecedented, but their occurrence has always been extremely local, and no previous instance has occurred since data became available of a deficiency approaching 50 per cent.

The conditions in the east of Kent were of a very remarkable nature. In parts of this district every month of the year had a rainfall below the average, and at one or two stations the total for the year fell short of 10 inches (250 mm.). Less than 12 inches (300 mm.) fell over a very large area in the lower Thames Valley and in the Fen District. In London, where fairly comparable statistics of rainfall go back to 1774, the year's fall was by far the smallest ever recorded.

Evidence of the remarkable nature of the year is shown in almost every section of the volume. The total duration of rainfall was at most stations far less than any previously recorded and the number of days with rain was probably also unprecedentedly small, less than 100 rain days occurring over a large area in the south-east of England. The number of days on which ·04 inch (1·0 mm.) of rain fell was in some places as low as 60. The infrequency of thunderstorms and of heavy cyclonic rains was a notable feature. In contrast with the conditions which prevailed in the south and east, the rainfall of the year in the west of Scotland was above the average. This is a phenomenon which has been common during previous droughts in England.

The volume contains an article comparing the rainfall data of the year with those of previous years in which prolonged dry periods occurred. These included the memorable droughts of 1868, 1879–80, and 1887; and the shorter, but in some respects more severe, drought during the spring of 1893. Other special articles deal with the correlation of rainfall statistics with those of epidemic scarlet fever and with the geographical aspects of annual rainfall fluctuation in the British Isles. The general tables of rainfall include records for 5,079 stations, an increase of 127 over those published in the volume for 1920, showing that the normal growth of the observing staff has been resumed after the depression caused by the War. There has been a distinct improvement in the distribution of the stations, especially in Scotland.

Professional Notes, No. 28. A Comparison of the Anemometer Records for Shoeburyness and the Maplin Lighthouse. By N. K. Johnson, B.Sc., and S. N. Sen, M.Sc. 1922. Price 6*d.* net.

THIS note gives details of an investigation of the anemometer records at Shoeburyness and at Maplin Lighthouse. Records for ten months of 1919 were utilized. The two stations are 12 miles apart, and the anemometers are almost identical in construction; that at Shoeburyness is, however, some 40 feet higher than that at Maplin. The high correlation coefficients show that there is a close relation between the wind speeds at the two places. The highest correlation coefficient obtained was ·93 for south, *i.e.* on-shore, winds, and the lowest ·72, for north, *i.e.* off-shore, winds.

Professional Notes, No. 30. Diurnal Variation of Temperature as affected by Wind-velocity and Cloudiness: a Discussion of Observations on the Eiffel Tower. By Captain J. Durward, M.A. 1922. Price 4*d.* net.

THE observations used in this investigation are those recorded at Parc St. Maur and at the top of the Eiffel Tower for the five months May to September during the years 1905–1909. Days and nights are considered separately, and these are again divided into "fair" and "cloudy." It is well known that cloudiness and turbulence are factors of temperature changes, but the numerical relation between the several factors is not readily obtainable. This gap in meteorological statistics is, in part, filled by Captain Durward's work.

Discussions at the Meteorological Office.

November 13th, 1922. *Het Klimaat van Nederlandsch-Indie.* By C. Braak. (Koninklijk Magnetisch en Meteorologisch Observatorium te Batavia. Verh. No. 8, Vol. I., part 2, 1921). *The Climate and Weather of the Philippines,* 1903–1918. By J. Coronas. (Manila: Philippine Weather Bureau, 1920.) Opener—Mr. C. E. P. Brooks.

The two papers under discussion are both valuable contributions to the climatology of the East Indies. The subject does not lend itself to a brief summary.

November 27th, 1922. *Die Zirkulation der Atmosphäre in den Gemässigten Breiten der Erde.* By A. Defant. (Stockholm: Geografiska Annaler, 1921, Vol. 3, pp. 209–266). Opener—Mr. R. G. K. Lempfert.

In this paper the author has applied the ideas underlying the theory of eddy motion to the general circulation of the atmosphere and regarded the air flow in temperate latitudes as a case of steady motion on which is superposed eddy motion on a large scale, the cyclones, anticyclones and other disturbances being taken as the counterpart of the eddies experienced in the wind. He has endeavoured to work out the balance between the heat conveyed from the tropics towards the poles by this process, the heat received from the sun, and that lost by radiation. Some details in the analysis do not command full confidence, but the paper is suggestive and gave rise to an interesting discussion.

The subjects for discussion at 5 p.m. on Monday, January 22nd, 1923, will be :

Meteorological Conditions for the formation of rain. By J. Bjerknes and H. Solberg. (Geofysiske Publikationer, Vol. II., 1922, No. 3.)

Life Cycle of cylcones and the polar-front theory of atmospheric circulation. By J. Bjerknes and H. Solberg. (Geofysiske Publikationer, Vol. III., 1922, No. 1.)

The Royal Meteorological Society.

THE first meeting of the present session was held on November 22nd, Dr. Charles Chree, President, in the chair. Sir Napier Shaw gave an account of the proceedings* of the International Union for Geophysics and Geodesy which met at Rome in May 1922. A paper by Major Goldie followed.

A. H. R. Goldie, M.A.—Circumstances determining the distribution of temperature in the upper air under conditions of high and low barometric pressure. In this paper Major Goldie shows how the observations which are now being made day by day in aeroplanes can be utilized to throw light on the vexed question of the structure of the atmosphere in regions of high and low pressure. For this purpose he reviewed all the temperature observations made in the British Isles during the last three months of 1921. The maps of the *Daily Weather Report* were studied and showed whether the air in which the ascents took place was to be regarded as polar or equatorial. In the majority of cases the regular temperature lapse-rate showed that the currents extended to considerable heights, but there were a few instances of inversions where there was polar air near the ground and equatorial air above. Major Goldie is led to adopt the view that the well-known association of low pressure with a cold troposphere, a low tropopause and a warm stratosphere is due to the fact that air in the polar regions has all these characteristics and that they are therefore to be expected in a polar current, *i.e.*, in air which has recently come from such regions. Similarly with equatorial air. The hypothesis explains the occasional combination of low temperature near the ground with high pressure as due to the presence of equatorial air over polar air.

---

* See *The Meteorological Magazine,* June 1922, p. 120.

It will be seen that the paper gives strong support to the theories of the Norwegian school, and is opposed to the idea that the contrast between the temperature distributions in cyclones and anticyclones is to be explained by the expansion and compression of the air as it rises and falls in the course of the adjustment between pressure and the centrifugal and "geostrophic" forces.

Certain difficulties were mentioned in the course of the discussion, emphasis being laid on the various reasons which make a sharp division between the categories, equatorial air and polar air, impracticable except in somewhat special circumstances.

Correspondence.

To the Editors, *The Meteorological Magazine.*

Cloud Transformations.

MR. G. A. CLARKE has asked for suggestions upon how the transformation from cirrus to cirro-cumulus can take place (see *The Meteorological Magazine*, 1922, pages 182–183). I have observed such changes occurring, apparently, in two ways. One is by the convectional breaking up of cirrus and cirro-stratus into cirro-cumulus. In this case the cirrus and cirro-stratus are formed by mixture, by general elevation, or possibly by radiation. Before their formation no thermal convection could take place locally in the air-sheet in question, unless the lapse-rate equalled or exceeded the adiabatic; after the formation of cloud, however, thermal convection may occur with any lapse-rates exceeding merely the retarded adiabatic. The process of the break-up of smooth sheets of lenticular alto-stratus into alto-cumulus by convection induced in this way is commonly to be observed, and gives us what I consider to be our most beautiful clouds. (*Cf.* Mr. Clarke's plates 14A, 14B, 18A, 20B, 21A, and 22B, in his recent book on clouds.)

A variant of this process is by evaporation of the cirrus and re-condensation of the vapour in the lower levels of the snow trails. This re-condensation, which may occur first in the form of thin sheet clouds, may not be evident against the more brilliant background of the existing cirrus trails, until the thermal convection breaks the sheet into cirro-cumulus as described above. The levels of the movements of the cirrus and new cirro-cumulus may not be easily distinguishable.

A second process by which cirro-cumulus may " form from cirrus " is through thermal convection induced directly by the cold snow trails. The rise of the relatively moist air between dense cirrus trails, hanging perhaps more or less regularly from convectional columns above, may, on occasion, produce new cirro-cumulus, and in any event, produce disturbances in the cirrus trails. (Such as, perhaps, those in Mr. Clarke's plates 7B, 8B, and 12B, in his book on clouds.)

CHARLES F. BROOKS.

Clark University, Worcester, Mass., U.S.A., September 23, 1922.

Exceptional Visibility as a Sign of Coming Rain.

THE result of Mr. Pick's investigation, an account of which appeared in the October number of this magazine, as to whether a visibility of 21 miles or more can be regarded as a portent of rain, is of interest.

But may I point out that when Mr. Pick refers to " the widely-held belief that exceptional visibility is a sign of coming rain," exceptional visibility in this sense surely implies something more than a visibility of 21 miles or over. It implies a peculiar type of visibility which gives the impression of nearness. The air is remarkably transparent, and distant objects are unusually distinct. Meteorological observers in this country indicate this state of atmospheric transparency by the use of the Beaufort letter " v." It is this apparent " nearness " of distant objects which is widely believed to be a sign of coming rain. A visibility of 21 miles or more may often be observed, when an experienced observer would not log Beaufort " v." An idea of the frequency of occurrence of Beaufort " v " may be obtained from the fact that at Valencia Observatory, Cahirciveen, where visibility is, on the average, very good, Beaufort " v " has been observed during recent years on about 15 to 20 days per annum.

I think that one might reasonably maintain that Mr. Pick, in taking observations of visibility of 21 miles or more as expressing the same atmospheric conditions as implied by Beaufort " v ", has not necessarily disproved the widely-held belief that exceptional visibility is a sign of coming rain.

The Valencia observations show, however, that for the Atlantic coast, at any rate, the belief is not justified.

P. I. MULHOLLAND.

5, Grenville Place, S.W.7, Oct. 22, 1922.

As to visibility, I hardly think the dry years of 1920 and 1921 can be quite sufficient evidence to disprove the popular theory.

As a rule when the hills this side of Sevenoaks, 22 miles off, are clear and dark, rain follows, and still more so when the flashes of the Gris Nez Lighthouse, 42 miles away, are distinct, or when the glare of London, 48 miles to the north-west, is plainly seen.

I particularly noticed this glare on the evening of September 18th this year after a very fine day with high barometer and no other sign of change. September 19th was wet and windy enough any way.

J. Ellis Mace.

View Tower, Tenterden, October 19th, 1922.

A Huge Water Spout.

(From the *Daily Malta Chronicle*, October 26th, 1922.)

" During the night of Saturday, October 15th, while the Royal Fleet Auxiliary *Bacchus* was threading her way between the various islands of the Grecian Archipelago terrific thunder storms were encountered, accompanied by torrential rainfall, which lasted the whole night through and the great part of the following day. On the Sunday morning at 8.35 a.m., during a dazzling display of forked lightning and loud rumbling roars of thunder, the officer on watch was astonished to see, about 4 miles away from the ship, a long black looking streak of water, no thicker than a man's arm in appearance, shoot straight out of the sea to a height of 1,000 feet. Immediately this streak of water began to increase its dimensions until, in the space of two or three minutes, it had developed into a gigantic water-spout of 1,800 feet in height and 50 to 60 feet in diameter. Luckily it was travelling away from the vessel, but after eight minutes the most amazing spectacle was witnessed. From about half its height the water-spout bent to an angle of 45 degrees and then straightened out again. This feat was performed twice and the water dropping from this huge column created a base spray of 100 feet. After sixteen minutes existence, and as suddenly as it commenced, the water-spout collapsed amid a high commotion of sea. Everyone on board, and there are some [with] long service amongst them, agree that such wonderful specimens of a water-spout are seldom seen, and once seen never forgotten.

W. H. Gibson."

[According to accepted ideas the shooting of the water-spout from the sea must be regarded as an optical illusion. The column is formed by the condensation of water in the centre of the whirlwind. There is usually much turbulence at the foot of the water-spout where water is being sucked up. The reference to water dropping from the column as the cause of base " spray " must be accepted with reserve.—Ed., *M.M.*]

A Persistent Rainbow: Porlock, September 16th, 1922.

The persistent rainbow observed over the Porlock Valley from Dunkery Beacon is not an unusual occurrence in that district, as the clear patch of sky over the valley is nearly always, to a greater or less degree, present at certain times, when moist south-westerly winds blow. The general sequence of events is interesting. Before rain sets in or low cloud forms on the Exmoor heights, a band of cloud appears apparently over the middle of the valley, which is about 3 to 4 miles wide as measured from crest to crest of the hills bounding it. This band runs, roughly, north-west to south-east, and invariably has a smooth edge on its windward side. Its height is extremely difficult to judge, but must be 5,000 feet, or more, and it might be classed as lenticular strato-cumulus. The under-surface is dark and smooth. The position varies somewhat on different occasions, being sometimes nearer the Dunkery range than on others. This cloud-bank is a splendid guide to local weather likely to be experienced in the immediate future. So long as it is formed, no rain will fall in the adjacent valleys; but as soon as it begins to disperse rain may be expected. This part of Exmoor has a general slope upwards from south to north, culminating in the Dunkery range on its northern edge. From clouds observed, it seems that there must be a very considerable upward current from this edge, and it is this flow of air that forms the cloud-band. Small ragged fracto-stratus can frequently be seen rising, apparently from the valley, at a height of about 2,000 feet, evidently due to up-currents from the vale and in no way connected with the upper flow which forms the band. As the air becomes moister, cloud forms on the southern hills and drizzle sets in, while the high stationary band and the small fracto-stratus gradually disperse. Soon afterwards light drizzle commences, but rarely cloud forms on the North Hill on the northern side of the valley. The drizzle gradually spreads down the northern slopes of Exmoor to the valley; but often this is of short duration, and a clear patch of sky in much the same position as the cloud-band is formed, which gives rise to the rainbow effect in the drizzle over the North Hill. It thus appears that the flow of air at first has a considerable upward tendency, but later passes through horizontal to downward motion, after the local up-currents from the valley have ceased owing to the general equalising of temperature by the gradual spread of the drizzle into the valley area.

The time occupied by these changes, of course, varies considerably, and in the case of the latter stages may last for days.

Pilot-balloon ascents would doubtless clear up several points as to the air motion, which must necessarily remain obscure when eye observations alone are possible. T. F. Twist.

Fawley, Hants, Nov. 22, 1922.

Turnip-like Clouds.

ON Tuesday evening, October 10th, towards 17h, I observed a curious form of cloud. What struck me was the repetition of this form (like a turnip) in three separate clouds. The three clouds were fairly close to one another, about 10° or 15° above the horizon. The " outside left " specimen was almost due east-by-north and the " outside right," the largest of the three, practically due east, almost over the northern extremity of the low wooded hills situated east-south-east of the Observatory at a distance of 1½ miles. These hills are 400 feet high. The " turnip " clouds, which resembled cumulus in structure, being " puffy " like that type of cloud, but which had the pendants characteristic of tornado clouds, appeared to be stationary throughout the period in which I observed them until their disappearance, which was rather sudden. The phenomenon lasted about half-an-hour. The rest of the sky was covered with roll strato-cumulus (small rolls), amount 10, and wind was " calm."

I should be very glad to have your opinion on this curious phenomenon.

F. J. PARSONS.

County Observatory, Ross-on-Wye, Oct. 13th, 1922.

Meteorology and Folklore.

The Wind.

THE wind probably forced itself early upon the attention of man. He asked, naturally enough, " Was it divine ? " " Could it be commanded ? " This latter question is " answered " all over the world by magicians, who at all times and in every place have professed to control the wind.

This belief is mentioned in the Northern sagas. In Shakespeare, both the witches in *Macbeth* and Prospero in *The Tempest* command the elements. It was believed that witches raised a storm in order to wreck James VI. of Scotland and his bride. Nor is the belief quite extinct, since Sir J. G. Frazer tells us that the Esthonians attribute the bitter northerly winds of spring to the spells of Finnish wizards. They dread in particular three days called the Days of the Cross, one of which is Ascension Eve, and are afraid to go out on these days :—

" Wind of the Cross ! rushing and mighty !
Heavy the blow of thy wings sweeping past :
Wild wailing wind of misfortune and sorrow,
Wizards of Finland ride by on the blast."

Any sudden wind may be supernatural—it is so inexplicable. So not only the formidable sand-storms of desert regions but the small dust whirls of our roads are almost universally ascribed to spirits. To the Irish and Scots they are due to the fairies, to the Arabs they are the "Jan," while the Californian Indians say they are happy souls going to heaven. Some peoples make warlike demonstrations to drive away the demon, like the Esthonians, who run shrieking and shouting after a whirlwind, throwing sticks and stones at it. In some parts of Austria and Germany the peasants, during a wind, open a window and fling out a handful of meal, saying: "There, that's for you; stop!" In the south-east of France the Wandering Jew was said to be carried from place to place by the wind. This was probably a survival of the ancient Teutonic belief in the wind-god Odin or Wotan (derived from a Sanskrit root "to move"), who was said to ride through the air on his grey or white horse, or wander in disguise over the face of the earth, for the wind must wander.

The Hebrews thought of the winds as the messengers of Jehovah as in Psalm civ. In The Book of the Revelation the seer sees the four winds held by four angels at the four corners of the earth. Later Jewish legend tells of the "Angels of Wind and of Fire" who died as soon as born, as in Longfellow's beautiful lines:—

"The Angels of Wind and of Fire
Chant only one hymn, and expire
With the song's irresistible stress;
Expire in their rapture and wonder,
As harp-strings are broken asunder
By music they throb to express."

CICELY M. BOTLEY.

10 *Wellington Road, Hastings, September 30th,* 1922.

The Design of Rain-gauges.

WITH regard to gauges with high or low rims—I have had the two patterns for over 50 years and invariably find the Snowdon or Meteorological Office pattern gives the larger total for the year. The high rim catches more rain on showery days, but it protects the funnel in case of dew, the open gauge registering ·006 in. against ·004 in. or less in the standard shape and I often get 10 more "rain days" from this cause, chiefly in autumn or winter fogs and heavy dews. On the other hand, it is seldom that the fact that in high wind or hail the high rim catches more, makes the difference between a catch of less than ·005 in. into one reaching that limit and so as to add to the number of "rain days."

J. ELLIS MACE.

View Tower, Tenterden, October 19th, 1922.

NOTES AND QUERIES.

The Effect of introducing Ammonia into Pilot Balloons.

It having been suggested that the height reached by a pilot balloon might be increased by treating the rubber with ammonia gas before filling the balloon with hydrogen, Mr. L. H. G. Dines has been making some experiments at Benson, comparing the bursting size of balloons treated with ammonia and untreated.

The method of procedure was simply to put about ten drops of strong ammonia solution into a balloon and tie up the neck some two or three hours before filling it with air. The four balloons tested were slowly filled with air until they burst; the circumference at bursting could be measured by means of a piece of cotton to within a centimetre.

The circumference before filling was approximately 54 cm. in each case, but no attempt was made to determine it very closely.

The table below gives the particulars and results of the experiment. It will be noticed that the effect of the ammonia is not great, but that as far as it goes the experiment shows a slight advantage to be obtained by the treatment. The figures seem to be too consistent to be attributed entirely to chance, and it would be worth while making further trial of the process.

The balloons tested were all of good quality and none of them showed any signs of pin holes at any time before the final burst.

It is to be observed that if these particular balloons had been filled with hydrogen to give a velocity of 500 feet per minute their bursting size would have [corresponded with a height of about 7¾ kilometres. Such a height would not often be attained in practice by balloons of this size inflated for a velocity of 500 feet per minute.

A possible explanation may be that the rubber is less durable at the low temperatures of the upper air than under the warmer conditions of the laboratory.

Colour of balloon and treatment.	Weight of balloon.	Circumference at time of burst.
	Grammes.	Cm.
White. No ammonia, but warmed a little -	19·6	196
White. Not warmed; treated with ammonia gas	19·7	204
Blue. No ammonia, but warmed a little	19·5	217
Blue. Not warmed; treated with ammonia gas -	19·5	234

It is of interest to note that Mr. Dines's experience with registering balloons (made of much thicker rubber than pilots) is that when a balloon has been filled with ammonia gas for a day or two the smell comes through, but before that no smell can be detected outside. When rubber has been in contact with ammonia for some time the smell clings to it in a measure that suggests there has been more than superficial contact.

Evaporation from a Tank at Valencia Observatory.

A table in *British Rainfall, 1921,* gives the evaporation from a tank at Valencia Observatory, Cahirciveen, for the eleven months February to December, 1921. The following particulars of the tank and its exposure may be of interest.

The body of the tank is made of concrete, giving a water surface of 6 ft. square and a normal depth of 2 ft. All round the top of the concrete walls, which are 6 inches thick, a piece of 2½ in. × 2½ in. angle-iron is fixed, forming a definite edge flush with the inner face of the wall. A watertight joint is maintained between the iron and the concrete by means of pitch. The water level was normally maintained at about five inches below the top of the angle iron : the top of the wall is about one inch above the surrounding ground. The water level was thus not far from the ground level at any time.

The experience gained shewed that this form of tank in not very satisfactory, it is very difficult to make concrete walls watertight enough, even though every precaution may be taken in construction, and it was finally found necessary to coat the bottom with pitch. This had the desired effect, and whatever leakage still existed was entirely negligible.

The tank is built in a grass field not far from the estuary of the Valencia River, in an open exposure. In wet weather, when anything more than a light wind was blowing, a great deal of trouble was experienced owing to water splashing into the tank on the windward side from the top of the walls and the surrounding ground, making it impossible to determine the net evaporation by the usual method of deducting the rainfall from the depth of water in the tank.

It is evident in this connection that if water splashes in on the windward side it will at the same time splash out on the lee side, but there is reason to believe that the amount is much less. For one thing, direct observation during rainfall shewed this to be the case; it was also inferred by comparison with several rain-gauges, one of which was, owing to a bad exposure, suffering from excessive in-splashing. With none of the gauges was the fall recorded always sufficient to account for the water found in the tank.

For this reason it was deemed undesirable to attempt to determine the mean monthly evaporation for all days indiscriminately, and only that on dry days has been published in *British Rainfall.*

It frequently happened that the maximum daily evaporation in a month occurred on a day of rain, and for the reason given above it is probable that the evaporation on such occasions was greater than the computed value which has been published. The principal factors in determining the amount of evaporation are a strong wind and dry air, conditions which are often associated with showers when a west-north-west or north-west wind is blowing at Cahirciveen.

It is a very difficult matter to determine the true evaporation from a tank on a rainy day and it is probably safe to say that it cannot be done directly at the present time. Not only is there the difficulty of water splashing into or out of the tank, but the rain-gauge itself is far from being a perfect instrument for determining the true depth of rainfall in windy weather.

It has been suggested that the tank records should be regularly compared with that of a Piche evaporimeter. If it be then assumed that there is a constant relationship between the true evaporation from the tank and that from the evaporimeter, irrespective of rain, then, from a comparison based on fine days only, the evaporation from the tank on all days may be computed. This method has much to recommend it and is being tried at Valencia Observatory at the present time.

The best kind of exposure for an evaporation tank is a matter of some dispute. If it be placed in a very sheltered position with a rain-gauge beside it, it is clear that the difficulty found at Valencia Observatory will be greatly minimised. Not only is the in and out splashing greatly reduced, but the rain-gauge itself will measure more accurately the true depth of rain falling into the tank under sheltered conditions, though in that case the primary factor connected with evaporation—a free play of air across the surface of the water—has been altered in a manner very difficult to standardize. If all tanks were exposed in open fields they would at least all be comparable in dry weather, but if they are in any way sheltered there is considerable risk that the mean evaporation is as much the result of a different exposure as of the climatic condition of the locality. It does not seem that this aspect of the case has been sufficiently emphasized.

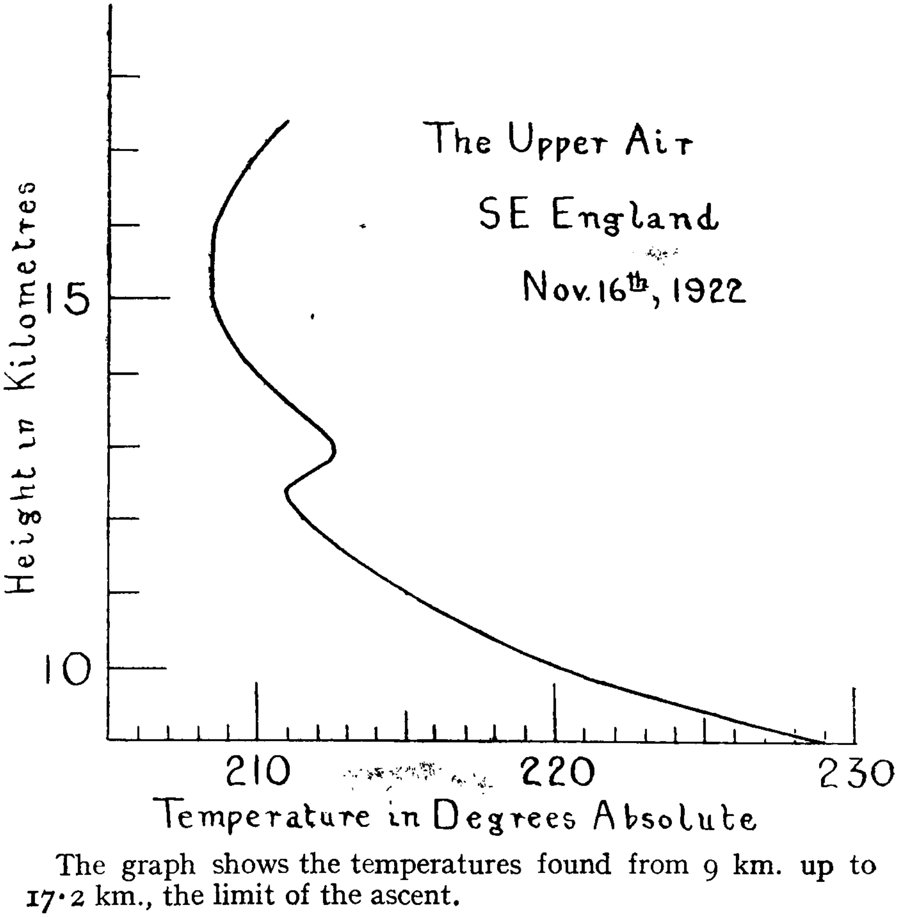
L. H. G. Dines.

Unusual Conditions at the Base of the Stratosphere.

A REGISTERING balloon was sent up from Benson on November 16th, 1922. Pressure was very high on the day of this ascent, and low clouds prevailed over England. Upper clouds were seen, however, in Scotland; the Aberdeen observations show that at the cirrus level the air movement was from the north.

The temperature conditions at the base of the stratosphere were very unusual. A lapse rate of 7a (12·6° F.) per kilometre was found between 11 km. and 12 km. and the stratosphere commenced with an inversion of 1·5a (2·7° F.) at 12·1 km. From 13 km. to 15 km. the lapse rate was again maintained at very nearly the same value as below the inversion. From 15 km. to 16 km. the temperature was uniform and above that it rose steadily at the rate of 3a (5·4° F.) or 4a (7·2° F.) per kilometre.

It would be of interest to learn whether a double inversion accompanied by such steep lapse rates has been recorded in the neighbourhood of the stratosphere on any other occasion.



The graph shows the temperatures found from 9 km. up to 17·2 km., the limit of the ascent.

"May Dust."

A NOTE on "May Dust" was published in *The Meteorological Magazine,* July 1922, p. 163. An explanation of this phenomenon is given in *The West India Committee Circular* of November 23rd, 1922.

"The phenomenon believed to be 'May Dust,' which was observed throughout the Windward and Leeward Islands, the Virgin Islands and Tobago, as well as in Jamaica and Porto Rico, in the middle of May this year, was mainly attributed to volcanic action by various correspondents in *The West India Committee Circular,** who were struck by the resemblance which the haze bore to that noticed in Barbados in 1902 during the eruption of the St. Vincent Soufrière. Another explanation, however, is given by Mr. Oliver L. Fassig, the meteorologist in charge of Porto Rico Station, in his useful series† of 'Climatological Data.' Mr. Fassig says that a microscopical examination, while not revealing the source of the dust, makes it certain that it is not of volcanic origin. The most probable explanation, he thinks, for the wide extent of the haze is that great quantities of dust were carried aloft during one of the severe dust storms of the African deserts and then carried westward by the trade winds."

Leakage of Air into a Barometer Tube.

A MERCURY barometer with an unusual defect was recently brought to the Meteorological Office. The barometer, which was of considerable age, had been brought to London from the country, and on arrival mercury was up to the top of the tube. Inversion and judicious tapping apparently set matters right, but when the barometer was left to itself the mercury rose at a rate of about an inch an hour. When the tube, which was of uniform bore, was taken from its frame it was seen that bubbles formed at one particular spot on the glass about the middle of the tube. Each bubble grew to a certain size, then broke away and rose to join its predecessors in a larger bubble an inch or two up the tube.

No flaw could be seen in the tube at the spot where the bubbles were forming, but whilst it was under examination the tube snapped as if it had been in a state of strain. One of the fractures was at the place where the bubbles had formed. This fracture was clean with a radial crack from the bore half-way to the outer surface.

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* No. 619, June 2, p. 294, and succeeding issues.

† *U.S. Department of Agriculture, Weather Bureau. Climatological Data. West Indies and Caribbean Service,* Vol. II., No. 5, May 1922.

Obituary.

Cargil Gilston Knott.—We regret to record the death, on October 26th, 1922, at the age of sixty-six, of Dr. Cargil Gilston Knott, F.R.S., Reader in Applied Mathematics in the University of Edinburgh. First a pupil, and then the assistant, of Professor P. G. Tait, Knott was from 1883 to 1891 Professor of Physics in the University of Tokyo, and whilst in Japan conducted a magnetic survey of that country and became absorbed in seismological problems. The last thirty years of his life were spent in the service of his own University, and for the last ten he was Secretary of the Royal Society of Edinburgh. He was President of the Scottish Meteorological Society at the time of its amalgamation with the Royal Meteorological Society two years ago, and the representative of the Royal Society of Edinburgh on the Advisory Committee for the Meteorological Office, Edinburgh.

Knott's devotion to a great master found expression in his admirable *Life of Tait* (Cambridge, 1911); he maintained in Edinburgh the traditions for which Tait had stood, and remained to the end a champion of quaternions. His published scientific papers are very numerous, and the most recent, in which he placed on record a new determination of the laws of propagation of seismic waves, perhaps the most valuable (*Proc. Roy. Soc. Edin.*, Vol. XXXIX., pp. 157–208). His book on *The Physics of Earthquake Phenomena* (Oxford, 1908) concerns itself chiefly with such phenomena as touch closely on physical theory.

Knott's generous mind endeared him to many friends, whom once made he never lost. It seems hardly possible that his place in the scientific life of the Scottish capital can be completely filled.

News in Brief.

WE regret to announce the death of Mr. Clement Lindley Wragge who was for many years Government Meteorologist of Queensland and who founded many observatories both in England and Australia, that at Ben Nevis being perhaps the best known. An obituary will be published later.

THE Prussian Aeronautical Observatory at Lindenberg has, since January, 1922, issued a monthly report of upper-air data. Wind, speed and direction, and temperature for each half kilometre from the ground up to 4 kilometres, are given, and a short account of the weather conditions prevailing during the month follows.

Corresponding data for August, 1920, to December, 1921, appeared in the *Zentralblatt für die gesamte Unterrichtsverwaltung in Preussen,* and an earlier series in *Das Wetter.*

It is announced that, through the Royal Aero Club, Messrs. Selfridge and Co. have offered a prize of 1,000 guineas for the first flight of 50 miles made by a British pilot with a British-built glider, the distance to be measured in a straight line from a given point of departure. The offer will remain open for one year, from January 1st, 1923. In the event of no award being made, 500 guineas will be given for the longest flight, greater than 25 miles, made during the year.

The *Enfield Gazette* of November 3rd, 1922, reports that Mr. J. McEwan who has for 30 years compiled the "Weather Notes" for that paper is obliged by ill-health to give up the work at the end of the year. It is hoped that a successor to Mr. McEwan will be found.

Erratum.

November 1922, page 284—for the entries in the column headed " Ratio of shocks recorded to shocks due " *read* :

—
10 : 49
10 : 80
10 : 58
10 : 62
—
—

The Weather of November, 1922.

November 1922 was, speaking generally, a quiet, cloudy, but mild and dry month over the British Isles. The mildness was particularly noticeable in Scotland and the north of England. Before considering the sequence of events in detail, it is of interest to examine the general flow of air during the month in relation to the normal.

Taking the rough parallelogram defined by Iceland, the Azores, Munich and the north of the Baltic, during November, there is on the average an inflow over the western boundary and an outflow towards east and north, with little or no transfer of air across the southern boundary. During the past month the flow from the west was less than normal and the outflow towards east much increased, while the normal outflow towards north was reversed.

Reports from many parts of the country indicate that our smaller bird immigrants, such as various finches as well as larger but feeble flyers like the woodcock, have arrived on our shores in unusual numbers—perhaps a direct consequence of the generally quiet conditions.

On the morning of the 1st, a large depression centred off the north of Scotland was associated with a warm south-west wind current, and heavy rain and gales were general over the British Isles. By evening the depression had moved eastwards to southern Norway, and cold " polar " air was flowing over our area, causing sleet and hail showers and night frost, followed next day by brighter weather. On the morning of the 3rd a secondary was situated over south-west England, giving rain in southern England and northern France. This disturbance moved up the Channel over the Netherlands and finally left our area east of Petrograd on Sunday the 5th. Heavy rains associated with this depression caused a rapid rise in the levels of the Marne and Rhone. At Chalons the Marne was nearly five feet above its normal level and the lower parts of Lyons were flooded, while heavy snow, interrupting communications between Savoy and Italy, was reported on the Col du Lantanet and the Petit Saint Bernard.

Behind this distubance a wedge of high pressure moved eastwards across the British Isles to Russia, giving a short period of fairer weather. By the 5th, however, a new depression was approaching the Hebrides and rain was falling in the western districts. The new depression was centred over Scotland on the 6th and moved northwards on the 7th. Secondaries, however, caused rain on the 8th over the English Channel and southern Scandinavia.

A wedge of high pressure following this complex system continued to grow in intensity, except for a lapse on Friday the 10th, when a secondary of a deep depression over Iceland crossed the British Isles, and by the morning of the 11th a ridge of high pressure was established from the Azores to northern Russia. This anticyclone was the dominating feature of the weather charts for the rest of the month, though there were considerable local variations of weather as a result of its movements and the passage of depressions along its northern margin.

From the 12th to the 16th, depressions moved in a north-easterly direction with their centres north of Iceland and strong south-west winds caused relatively high temperatures in Iceland and northern Scandinavia. Low temperatures and much fog occurred over England, the Netherlands and Germany as a result of the clear skies and absence of definite wind currents.

A movement of the anticyclone to the west and an extension northward beginning on the 16th brought about a strong north-westerly wind current over Scandinavia with lower temperatures. Though coming to us from the north, the air over the British Isles was warm during this period and of equatorial origin, sweeping up the westward side of the anticyclone, far out over the Atlantic, to Iceland and then moving south to the British Isles. On the 20th, the anticyclone began moving eastward again and was centred over London on the 21st. The central parts of London experienced remarkable gloom on that day as the result of the formation of a pall of smoke at a height comparable with that of the roofs of buildings. Neither horizontal nor vertical air currents capable of dispersing the pollution existed and darkness as intense as that of night persisted almost throughout the day.

From the 21st, complex changes of pressure occurred and by the morning of the 24th, a crescent-shaped area of high pressure extended from Iceland over France to the Black Sea. Finally, the main anticyclone took up a position off south-west Ireland and the general conditions until the end of the month were similar to those prevailing between the 16th and 20th. A north-westerly current of "polar" air resulted in cold weather over Scandinavia and Central Europe, the highest temperature reported in this region on the 27th being 36° F. at Frankfurt. Over the British Isles the weather was much milder, though the surface wind direction was also north-westerly.

HEAVY floods occurred at Naples on the 4th, causing landslides and the collapse of several buildings, with some casualties. On the 28th it was reported that heavy snowstorms in Silesia had seriously impeded the frontier traffic with Poland.

Severe weather prevailed in mid-Atlantic from the 12th to the 14th. The Italian steamship *Monte Grappa* foundered on the 14th as a result of the shifting of her cargo. The crew were rescued by the White Star liner *Pittsburgh*. The ensuing week was, however, remarkably fine, an officer of the *Aquitania* stating that he could not recall a November voyage with so much sunshine and such smooth seas within the last 10 years.

From the 21st to the 23rd a violent gale was experienced at Sydney, Nova Scotia (Cape Breton Island) and over the island generally. Telegraph, telephone and power wires were blown down and the city was without light or power for tramway communication for over 24 hours. The gale is stated to be the worst that has occurred in the history of the island.

A Paris telegram, dated November 25th, gave details of torrential rains which had fallen in Algerian Sahara. The Biskra–Tuggourt railway was inundated at five points, and one train was surrounded by a flooded area extending for nearly 40 square miles. Tuggourt station was abandoned, and a large number of houses collapsed in places where there had been no rain since 1917.

Early in the month storms accompanied by floods were experienced over wide areas of the Cape and Transvaal. Shipping at Port Elizabeth was obliged to leave the roadstead. In many parts the rains were needed and proved very beneficial.

The special message from Brazil states that the rainfall was

(*Continued on p.* 322.)

Rainfall Table for November 1922.

STATION.	COUNTY.	Aver. 1881—1915.	1922.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days.
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	2·36	1·43	36	61	·46	5	9
Tenterden (View Tower)	*Kent*	3·02	1·51	38	50	·55	1	11
Arundel (Patching Farm)	*Sussex*	3·56	1·94	49	54	·62	5	10
Fordingbridge (Oaklands)	*Hampshire*	3·42	2·39	61	70	·86	5	19
Oxford (Magdalen College)	*Oxfordshire*	2·21	1·10	28	50	·42	5	11
Wellingborough (Swanspool)	*Northampton*	2·15	1·03	26	48	·25	1, 5	10
Hawkedon Rectory	*Suffolk*	2·27	1·47	37	65	·37	5	12
Norwich (Eaton)	*Norfolk*	2·57	2·01	51	78	·44	1	15
Launceston (Polapit Tamar)	*Devon*	4·24	2·74	70	65	·79	6	12
Sidmouth (Sidmount)	„	3·12	1·70	43	55	·40	5	12
Ross (County Observatory)	*Herefordshire*	2·53	1·39	35	55	·46	5	13
Church Stretton (Wolstaston)	*Shropshire*	2·94	1·80	46	61	·63	6	11
Boston (Black Sluice)	*Lincoln*	2·00	1·11	28	55	·38	6	9
Worksop (Hodsock Priory)	*Nottingham*	1·96	·91	23	46	·37	6	10
Mickleover (Clyde House)	*Derbyshire*	2·23	·90	23	40	·20	6	9
Southport (Hesketh Park)	*Lancashire*	3·14	2·53	64	81	1·19	6	17
Wetherby (Ribston Hall)	*York, W. R.*	2·34	1·25	32	53	·48	6	5
Hull (Pearson Park)	„ *E. R.*	2·19	1·61	41	74	·70	6	14
Newcastle (Town Moor)	*North'land*	2·42	·83	21	34	·20	3	11
Borrowdale (Seathwaite)	*Cumberland*	13·58	5·40	137	40	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	4·17	2·35	60	56	·84	5	22
Haverfordwest (Gram. Sch.)	*Pembroke*	5·02	2·24	57	45	·72	5	16
Aberystwyth (Gogerddan)	*Cardigan*	4·72	1·88	48	40	·51	6	6
Llandudno	*Carnarvon*	3·09	1·19	30	39	·34	3	15
Dumfries (Cargen)	*Kirkcudbrt.*	4·52	1·70	43	38	·72	5	10
Marchmont House	*Berwick*	3·00	·92	23	31	·21	10	14
Girvan (Pinmore)	*Ayr*	5·32	4·42	112	83	·99	10	24
Glasgow (Queen's Park)	*Renfrew*	3·73	2·15	55	58	·48	10	14
Islay (Eallabus)	*Argyll*	5·38	4·19	106	78	1·14	9	27
Mull (Quinish)	„	6·17	5·48	139	89	1·05	9	23
Loch Dhu	*Perth*	8·69	6·20	157	71	1·80	5	16
Dundee (Eastern Necropolis)	*Forfar*	2·44	1·37	35	56	·52	10	10
Braemar (Bank)	*Aberdeen*	3·84	1·62	41	42	·35	27	12
Aberdeen (Cranford)	„	3·22	2·20	56	68	·74	10	22
Gordon Castle	*Moray*	2·88	2·48	63	86	·60	25	19
Fort William (Atholl Bank)	*Inverness*	8·16	6·27	159	77	1·13	9	26
Alness (Ardross Castle)	*Ross*	4·02	2·38	61	59	·62	1	24
Loch Torridon (Bendamph)	„	9·27	7·51	191	81	1·02	30	28
Stornoway	„	5·83	3·74	95	64	·46	30	24
Loch More (Achfary)	*Sutherland*	8·55	9·93	252	116	1·04	25	29
Wick	*Caithness*	3·14	2·67	68	85	·67	25	26
Glanmire (Lota Lodge)	*Cork*	4·30	2·10	53	49	·57	5	15
Killarney (District Asylum)	*Kerry*	5·61	2·49	63	44	·47	5	20
Waterford (Brook Lodge)	*Waterford*	3·78	1·47	37	39	·76	5	11
Nenagh (Castle Lough)	*Tipperary*	4·02	1·27	32	32	·34	5	15
Foynes	*Limerick*	3·99	1·72	44	43	·53	5	15
Gorey (Courtown House)	*Wexford*	3·49	1·23	31	35	·60	5	12
Abbey Leix (Blandsfort)	*Queen's Co.*	3·34	·78	20	23	·20	5, 6	11
Dublin (FitzWilliam Square)	*Dublin*	2·67	·31	8	12	·10	6	9
Mullingar (Belvedere)	*Westmeath*	3·41	·78	20	23	·23	4	11
Crossmolina (Enniscoe)	*Mayo*	5·86	..	..	..	..	..	..
Collooney (Markree Obsy.)	*Sligo*	4·16	2·79	71	67	1·00	9	20
Seaforde	*Down*	3·79	1·54	39	41	·53	9	11
Ballymena (Harryville)	*Antrim*	4·05	2·33	59	58	·68	9	23
Omagh (Edenfel)	*Tyrone*	3·80	2·61	66	69	·75	9	24
Letterkenny Asylum	*Donegal*	4·85	2·82	72	58	·72	9	22

Correction—Stornoway, October, *for* "3·30 \| 84 \| 64," *read* "3·07 \| 78 \| 59."

Supplementary Rainfall, November 1922.

Div.	STATION.	RAIN.	
		in.	mm.
II.	Ramsgate	1·03	26
„	Sevenoaks, Speldhurst	1·95	49
„	Hailsham Vicarage...	2·14	54
„	Totland Bay, Aston Ho.	2·00	51
„	Ashley, Old Manor Ho.	1·95	49
„	Grayshott...........	2·17	55
„	Ufton Nervet........	2·05	52
III.	Harrow Weald, Hill Ho.	1·71	43
„	Pitsford, Sedgebrook..	1·38	35
„	Chatteris, The Priory.	·80	20
IV.	Elsenham, Gaunts End	1·28	33
„	Lexden, Hill House ..	1·36	35
„	Aylsham, Rippon Hall	2·30	58
„	Swaffham...........	1·44	37
V.	Devizes, Highclere ...	1·51	38
„	Weymouth..........	2·22	56
„	Ashburton, Druid Ho.	4·61	117
„	Cullompton	2·13	54
„	Hartland Abbey	1·88	48
„	Penzance, Morrab Gden.	2·01	51
„	St. Austell, Trevarna.	2·97	75
„	Crewkerne Merefield Ho	2·62	67
VI.	Clifton College	..	..
„	Ledbury, Underdown.	1·12	28
„	Shifnal, Hatton Grange	1·31	33
„	Ashbourne, Mayfield.	1·68	43
„	Barnt Green, Upwood	1·27	32
„	Blockley, Upton Wold	1·79	45
VII.	Leicester, Town Hall Sq.	·93	24
„	Grantham, Saltersford	1·20	31
„	Louth, Westgate	1·58	40
„	Mansfield, West Bank	1·28	33
VIII.	Nantwich, Dorfold Hall	1·22	31
„	Bolton, Queen's Park.	4·16	105
„	Lancaster, Strathspey.	2·54	65
IX.	Wath-upon-Dearne...	·78	20
„	Bradford, Lister Park.	·90	23
„	West Witton.........	1·03	26
„	Scarborough, Scalby..	1·86	47
„	Middlesbro', Albert Pk.	·72	18
„	Mickleton...........	..	..
X.	Bellingham	·78	20
„	Ilderton, Lilburn	1·57	40
„	Orton...............	3·05	77
XI.	Llanfrechfa Grange ..	2·35	60
„	Treherbert, Tyn-y-waun	5·28	134
„	Carmarthen Friary ..	2·18	55
„	Lampeter, Falcondale	2·18	55
„	Cray Station	3·00	76
„	B'ham W.W., Tyrmyndd	3·03	77
„	Lake Vyrnwy.......	3·07	78
„	Llangynhafal, P. Drâw	2·17	55
„	Oakley Quarries	5·65	143
„	Dolgelly, Bryntirion..	4·12	105
„	Snowdon L., Llydaw 9	..	..
„	Lligwy	1·83	47
XII.	Stoneykirk, Ardwell Ho	2·21	56
„	Carsphairn, Shiel.....	6·15	156
XII.	Langholm, Drove Rd.	2·10	53
XIII.	Ettrick Manse	2·71	69
„	North Berwick Res....	1·06	27
„	Edinburgh, Royal Ob.	1·20	31
XIV.	Biggar...............	1·72	44
„	Leadhills	5·63	143
„	Kilmarnock, Agric. Coll.	3·08	78
XV.	Dougarie Lodge.......	4·65	118
„	Oban................	4·99	127
„	Holy Loch, Ardnadam	..	..
„	Tiree, Cornaigmore....	..	..
XVI.	Loch Venachar	5·80	147
„	Glenquey Reservoir ...	4·10	104
„	Loch Rannoch, Dall...	2·48	63
„	Blair Castle Gardens ..	1·59	40
„	Coupar Angus....... .	1·58	40
„	Montrose Asylum	1·51	38
XVII.	Logie Coldstone, School	1·61	41
„	Fyvie Castle..........	2·85	72
„	Grantown-on-Spey ...	2·13	54
XVIII.	Kingussie, Fasnakyle..	1·78	45
„	Fort Augustus........	3·09	79
„	Loch Quoich, Loan ...	9·10	231
„	Fortrose	1·19	30
„	Faire-na-Squir........	4·15	105
„	Skye, Dunvegan	5·08	129
XIX.	Loch Carron, Plockton.	7·45	189
„	Dornoch, St. Gilbert's .	1·36	35
„	Tongue Manse	3·03	77
„	Melvich Schoolhouse ..	3·14	80
XX.	Dunmanway Rectory..	3·42	87
„	Mitchelstown Castle...	..	..
„	Gearahameen	..	..
„	Darrynane Abbey	3·50	39
„	Cashel, Ballinamona...	1·42	36
„	Roscrea, Timoney Park	·87	22
„	Broadford, Hurdlestown	2·09	53
XXI.	Kilkenny Castle.......	1·26	32
„	Rathnew, Clonmannon	·91	23
„	Hacketstown Rectory .	1·19	30
„	Balbriggan, Ardgillan .	·50	13
„	Drogheda	·33	8
„	Athlone, Twyford	..	..
XXII.	Castle Forbes Gdns....	1·63	42
„	Ballynahinch Castle...	..	..
„	Galway, Grammar Sch.	2·40	61
XXIII.	Westport House	4·13	105
„	Enniskillen, Portora...	2·08	53
„	Crossdoney, Kevit Cas.	1·10	28
„	Armagh Observatory ..	1·20	31
„	Warrenpoint	1·11	28
„	Belfast, Cave Hill Rd..	1·77	45
„	Glenarm Castle	2·43	62
„	Londonderry, Creggan.	2·97	75
„	Sion Mills............	2·73	69
„	Milford, The Manse ...	3·28	83
„	Narin, Kiltoorish	2·96	75
„	Killybegs, Rockmount .	4·12	105

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. from Normal
	mb.	mb.	° F.		° F.		° F.	° F.	° F.	° F.
London, Kew Observatory	1016·0	−0·2	84	1	45	16	68·4	51·1	59·7	+0·5
Gibraltar	1014·7	−1·1	89	26	57	6	77·2	62·5	69·9	−0·6
Malta	1015·2	+0·6	87	25	63	24	79·6	68·6	74·1	+2·1
Sierra Leone	1013·3	+0·6	91	3, 4, 5	69	20	86·1	73·6	79·9	−0·6
Lagos, Nigeria	1011·6	−1·3	88	2, 4	71	9. 25	85·1	74·7	79·9	+1·3
Kaduna, Nigeria	1012·2	−1·6	90	3	60	11	84·5	66·5	75·5	−0·5
Zomba, Nyasaland	1017·1	−0·3	85	18	50	22. 24. 25	75·0	54·4	64·7	+2·2
Salisbury, Rhodesia	1017·2	−3·0	80	6	32	22. 23	73·8	43·0	58·4	+2·0
Cape Town	1019·3	−1·0	81	8	34	26. 27	62·5	46·4	54·5	−1·3
Johannesburg	1022·2	−1·0	71	23	23	27	60·8	42·0	51·4	+0·7
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	..	..	68	23	25	27	59·2	34·1	46·7	−0·9
Calcutta, Alipore Obsy.	998·1	−0·9	95	11	75	7	88·7	78·3	83·5	−1·6
Bombay	1003·3	−0·9	92	1	76	21	87·8	80·0	83·9	0·0
Madras	1005·5	+1·6	107	14	75	1	100·9	80·9	90·9	+1·0
Colombo, Ceylon	1008·8	+0·5	88	4	73	2	86·5	77·4	81·9	0·0
Hong Kong	1005·1	−1·0	90	30	72	1	86·5	78·8	82·7	+1·2
Sandakan	..	..	91	14, 21	72	26	87·8	75·0	81·4	−0·3
Sydney	1018·8	+0·9	72	11	43	30	63·8	47·9	55·9	+1·5
Melbourne	1018·7	+0·2	67	17	32	24	57·2	41·4	49·3	−1·1
Adelaide	1019·5	+0·4	69	18	39	30	60·7	45·9	53·3	−0·1
Perth, Western Australia	1021·1	+3·1	72	4	39	25	63·6	48·4	56·0	−0·6
Coolgardie	1020·8	+1·7	74	5	32	26	63·1	43·4	53·3	+0·6
Brisbane	1018·2	+0·2	79	27	43	9	69·9	52·6	61·3	+1·2
Hobart, Tasmania	1018·0	+3·7	63	21	31	25	53·2	40·8	47·0	+0·2
Wellington, N.Z.	1023·2	+8·9	59	26	31	22	53·9	41·7	47·8	−1·9
Suva, Fiji	1013·2	−0·4	86	1	60	14	84·3	65·4	74·9	0·0
Kingston, Jamaica	1014·0	0·0	92	10	70	4	88·9	72·5	80·7	−0·6
Grenada, W.I.	1014·7	+1·4	87	3	72	4, 27	83·7	74·3	79·0	+0·2
Toronto	1014·3	0·0	91	7	45	13	77·1	56·3	66·7	+4·1
Winnipeg	1012·3	−0·2	96	5	37	9	77·8	51·5	64·7	+2·5
St. John, N.B.	1015·0	+1·0	77	5, 9	44	13	65·3	49·4	57·3	+0·8
Victoria, B.C.	1017·1	+0·2	78	19	45	17	64·8	49·7	57·3	+0·3

LONDON, KEW OBSERVATORY.—Prevailing wind direction W., mean speed 8·0 mi/hr. 1 day with hail, 1 day with thunder heard.

GIBRALTAR.—Prevailing wind direction E.

MALTA.—Prevailing wind direction NW. 3 days with hail.

SIERRA LEONE.—Calms predominate. 2 days with tornado, 11 days with thunder heard.

LAGOS, NIGERIA.—Prevailing wind direction SW.

SALISBURY, RHODESIA.—Prevailing wind direction easterly.

COLOMBO, CEYLON.—Prevailing wind direction WSW, mean speed 6·7 mi/hr. 1 day with thunder heard.

British Empire, June 1922.

TEMPERATURE				PRECIPITATION				BRIGHT SUNSHINE		
Mean	Absolute	Relative Humidity	Mean Cloud Am'nt	Amount		Diff. from Normal	Days	Hours per day	Percentage of possible	STATIONS
Wet Bulb. ° F.	Min. on Grass ° F.	°/o	0–10	in.	mm.	mm.				
54·4	33	62	6·3	0·98	25	− 30	10	7·5	46	London, Kew Observatory
63·0	54	71	3·2	0·61	16	+ 4	4	..	..	Gibraltar.
66·6	62	66	3·3	0·02	1	− 1	1	9·0	62	Malta.
75·5	..	77	7·4	15·86	403	− 87	25	..	..	Sierra Leone.
76·7	69	79	8·3	26·36	670	+187	21	..	..	Lagos, Nigeria.
69·8	..	75	1·0	6·76	172	− 53	12	..	..	Kaduna, Nigeria.
..	..	82	3·7	0·38	10	− 5	5	..	..	Zomba, Nyasaland.
51·0	..	51	1·5	0·01	Trace	− 1	1	..	..	Salisbury, Rhodesia.
50·6	..	76	5·9	4·18	106	− 7	15	..	..	Cape Town.
40·5	22	54	1·8	0·37	9	+ 6	3	8·8	84	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
36·8	..	74	3·2	2·05	52	+ 40	3	..	..	Bloemfontein.
80·1	69	79	9·3	22·89	581	+291	20*	..	..	Calcutta, Alipore Obsy.
78·7	69	77	6·8	26·63	676	+207	24*	..	..	Bombay.
77·3	72	57	5·8	1·30	33	− 15	12*	..	..	Madras.
78·5	72	75	9·0	9·86	250	+ 58	25	..	..	Colombo, Ceylon.
77·5	..	81	7·9	6·53	166	−232	16	6·1	45	Hong Kong.
76·5	..	82	..	8·69	221	+ 36	12	..	..	Sandakan.
51·6	36	70	4·1	1·26	32	− 95	12	5·3	54	Sydney.
47·2	29	80	5·8	1·80	46	− 7	15	..	..	Melbourne.
49·1	29	74	6·1	2·80	71	− 7	14	4·4	45	Adelaide.
52·9	29	75	5·0	4·09	104	− 68	18	5·7	57	Perth, Western Australia
49·8	28	62	4·4	0·67	17	− 14	5	..	..	Coolgardie.
57·6	37	70	4·6	1·83	46	− 19	8	..	..	Brisbane.
44·0	25	80	5·7	1·85	47	− 9	12	4·8	53	Hobart, Tasmania.
44·4	19	77	7·0	3·32	84	− 37	18	3·6	39	Wellington, N.Z.
71·6	..	83	5·9	1·82	46	−110	10	..	..	Suva, Fiji.
..	..	71	5·3	0·94	24	− 81	4	..	..	Kingston, Jamaica.
74·5	..	77	5·9	6·30	160	− 59	22	..	..	Grenada, W.I.
59·5	40	73	5·3	4·89	124	+ 54	11	..	..	Toronto.
58·7	..	67	4·0	2·28	58	− 25	10	..	..	Winnipeg.
53·7	41	87	7·0	3·07	78	− 5	16	..	..	St. John, N.B.
51·8	38	77	3·3	0·03	1	− 23	1	..	..	Victoria, B.C.

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

HONG KONG.—Prevailing wind direction S, mean speed 10·4 mi/hr. 4 days with thunder heard.

SANDAKAN.—Prevailing wind direction NE.

MELBOURNE.—11 days with fog. Night temperatures very low, 5 frosts.

PERTH, W.A.—Mean speed of wind 8·8 mi/hr.

WELLINGTON, N.Z.—Prevailing wind direction S. 1 day with hail.

SUVA, FIJI.—Wind direction variable.

GRENADA, W.I.—Prevailing wind direction E., 2 days with thunder heard.

(*Continued from p.* 317.)

slightly above normal in the centre and north of the country and irregular in the south. The atmospheric circulation was less active than in October, but several high pressure areas passed across southern Brazil and there were severe local storms with hail at various points in the centre and south, where some of the coffee plantations suffered damage. At Rio de Janeiro pressure during November was 4mb. above normal and temperature was slightly below normal.

A Correction.

With reference to the Barbuda hurricane mentioned on p. 288 of the November number of this magazine it is regretted that an error was made in the date. The hurricane occurred on the night of September 15th, and the centre of the storm is said to have passed directly over the island. Great damage was done to property, churches, houses and trees being blown down, but there was no loss of life. All shipping was driven ashore. The storm was experienced at Anguilla a few hours later, but the wind was less intense than at Barbuda. St. Christopher and Nevis Islands suffered practically no damage.

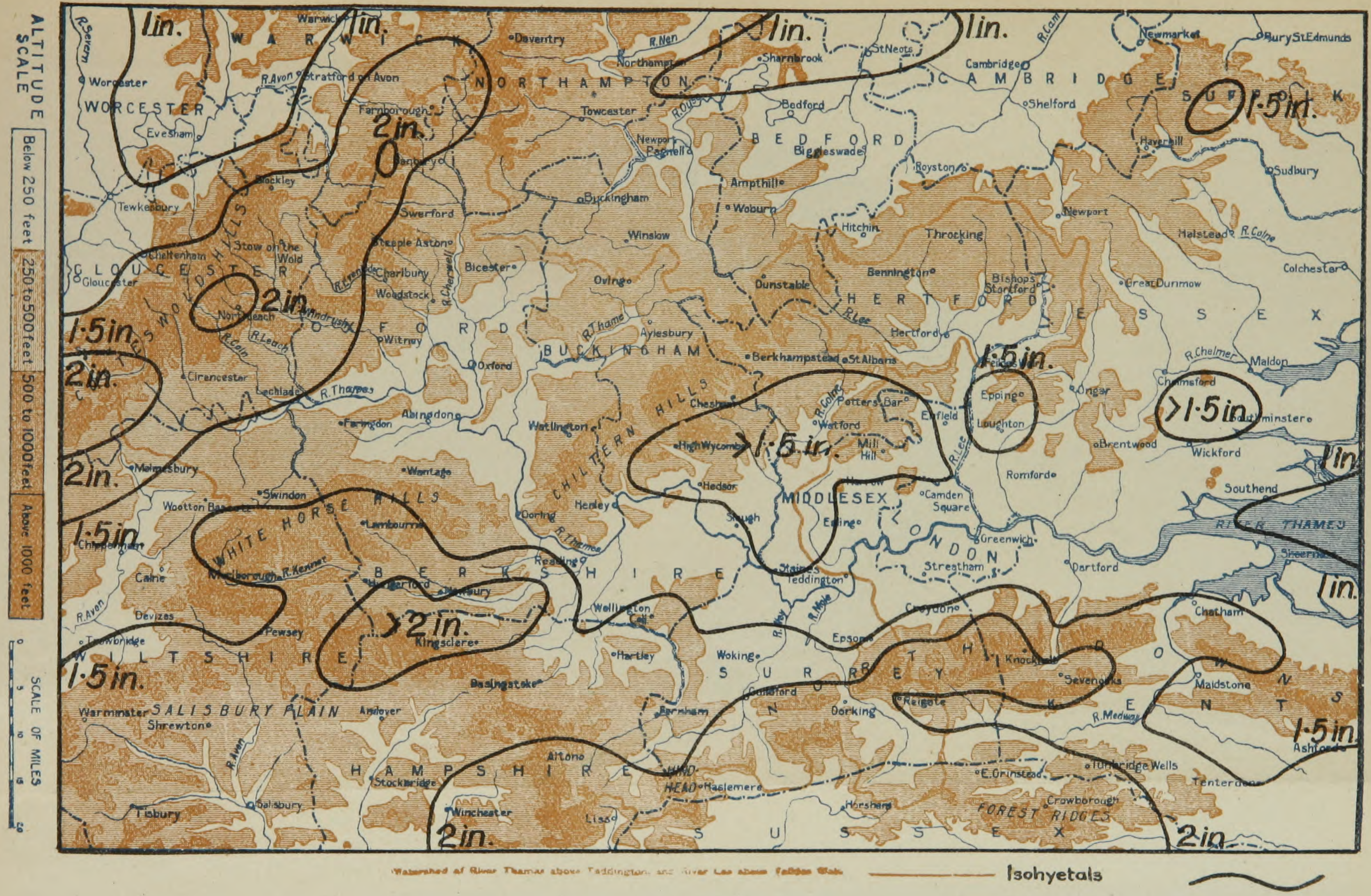
Rainfall in the British Isles.

THE deficiency of rainfall which occurred generally over the British Isles in October, continued in November, giving two consecutive months of abnormally low rainfall. The general rainfall in November was the smallest recorded since 1909, and for the two months together for a considerably longer period. The distribution of the rainfall in November 1922, differed from that of the preceding month in showing a greatly reduced tendency for excess along the east coast. The rainfall approximated most closely to the normal in the north-west where a considerable area had a deficiency of less than 25 per cent. The largest deficiency occurred in a broad band extending from the south-west of Ireland to the north-east of England, culminating at Dublin in a deficiency of 88 per cent. Over the greater part of the south of England the rainfall was between 50 and 70 per cent. of the average. The most unusual feature was a small area on the coast of Ireland, from Drogheda to Dublin, where the rainfall of the month was about 8mm. (0·3 inch). A considerable area in the eastern centre of Ireland and of England, as well as the north-east coast of England, had a rainfall of less than 25mm. (1 inch) for the month.

The general rainfall, expressed as a percentage of the average, was: England and Wales, 55; Scotland, 70; Ireland, 42; British Isles, 56.

In London, Camden Square, the mean temperature for November was 43·1° F., or 0·3° F. below the average. Duration of rainfall 28·2 hours. Evaporation, 0·27 inch.

THAMES VALLEY RAINFALL —— NOVEMBER, 1922.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ESSEX
MIDDLESEX
LONDON
BERKSHIRE
WILTSHIRE
SURREY
KENT
HAMPSHIRE
SUSSEX
COTSWOLD HILLS
CHILTERN HILLS
WHITE HORSE HILLS
SALISBURY PLAIN
HIND HEAD
FOREST RIDGES
R. Severn
R. Avon
R. Nen
R. Ouse
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R. Colne
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RIVER THAMES
Warwick
Worcester
Evesham
Tewkesbury
Gloucester
Cheltenham
Stratford on Avon
Blockley
Stow on the Wold
Northleach
Cirencester
Lechlade
Daventry
Northampton
Farnborough
Banbury
Towcester
Swerford
Steeple Aston
Charlbury
Woodstock
Witney
Bicester
Oxford
Abingdon
Faringdon
Wantage
Malmesbury
Swindon
Wootton Bassett
Chippenham
Calne
Marlborough
Devizes
Pewsey
Trowbridge
Warminster
Shrewton
Tisbury
Salisbury
Lambourn
Hungerford
Newbury
Kingsclere
Basingstoke
Andover
Stockbridge
Winchester
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Liss
Haslemere
Farnham
Hartley
Wellington Coll.
Reading
Goring
Henley
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Slough
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Watford
Potters Bar
Mill Hill
Enfield
Hitchin
Royston
Throcking
Bennington
Hertford
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Maldon
Burnham
Southminster
Ongar
Epping
Loughton
Brentwood
Romford
Wickford
Southend
Sheerness
Ealing
Camden Square
Greenwich
Streatham
Dartford
Staines
Teddington
Croydon
Epsom
Woking
Guildford
Dorking
Reigate
Knockholt
Sevenoaks
Chatham
Maidstone
Ashford
Tenterden
Tunbridge Wells
E. Grinstead
Crowborough
Horsham
ALTITUDE SCALE
Below 250 feet
250 to 500 feet
500 to 1000 feet
Above 1000 feet
SCALE OF MILES
0
5
10
15
20
Watershed of River Thames above Teddington and River Lea above Feildes Weir
Isohyetals

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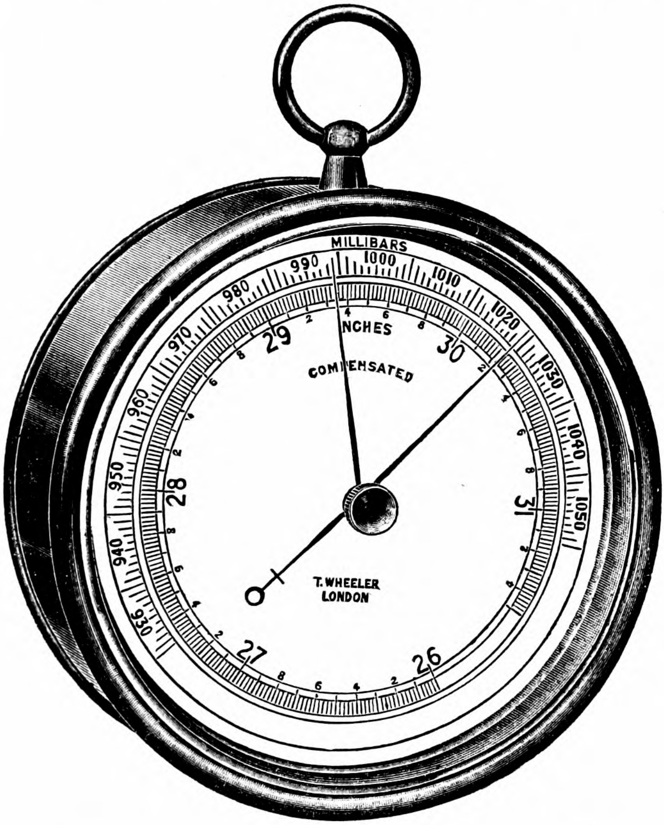
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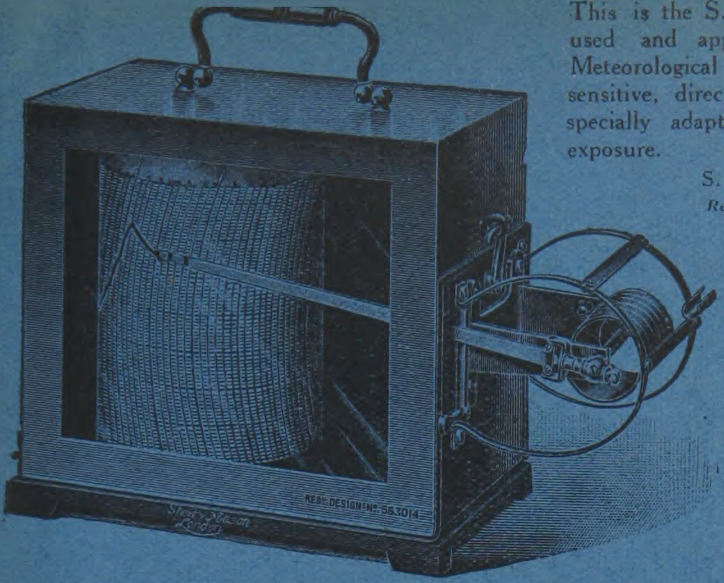

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A Monthly Review of Astronomy.

EDITED BY
F. J. M. STRATTON, M.A.; H. S. JONES, M.A., B.Sc.;
J. JACKSON, M.A., B.Sc.

Contains full Reports of the Meetings of the Royal Astronomical and Royal Meteorological Societies, and of the British Astronomical Association; Articles by various eminent Astronomers, English, American and Continental; Correspondence on topics of interest connected with the Science; Notices of Observatories, Publications and current Discoveries The "Oxford Note Book" is a special feature of the Magazine.

The Observatory was founded in 1877, and has become an established and very valuable publication.—*Prof. Young, in "Ten Years' Progress in Astronomy."*

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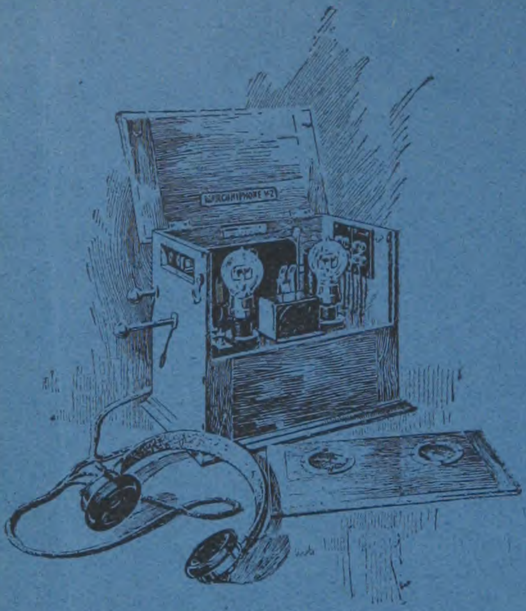

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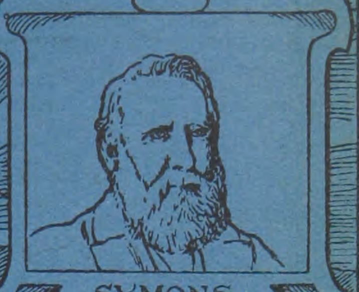

SYMONS.

THE METEOROLOGICAL MAGAZINE.

No. 684
JANUARY 1923
Vol. 57

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INCORPORATED WITH
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The responsibility for all facts and opinions expressed in the signed articles and letters published in this Magazine rests with their respective authors.

JANUARY, 1923.

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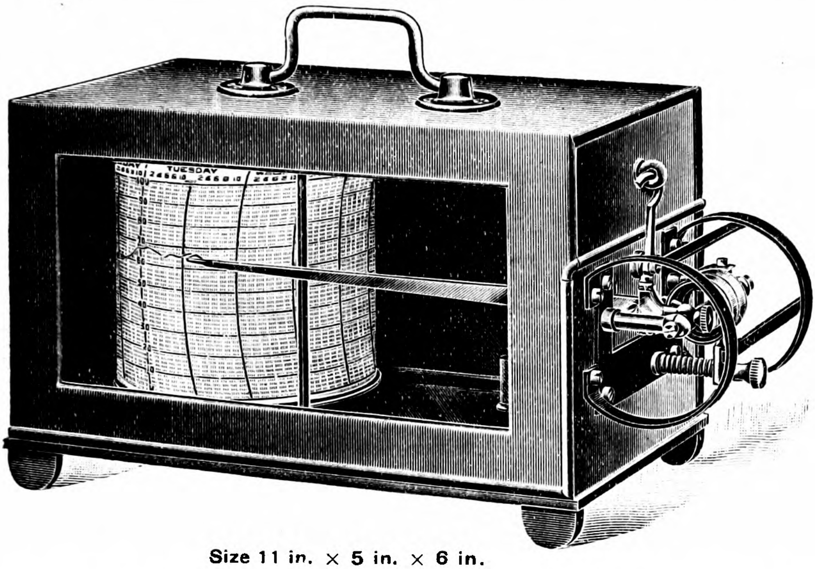

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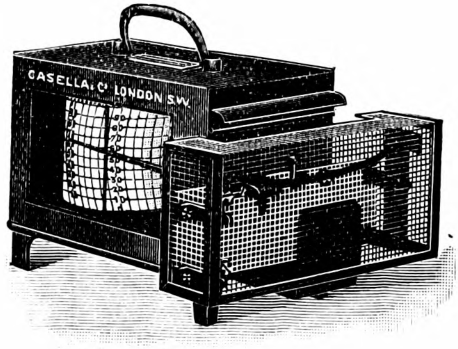

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EDINBURGH; or from THE METEOROLOGICAL OFFICE, SOUTH KENSINGTON, LONDON, S.W. 7.

The Line Squall of November 26th, 1922.

By E. G. Bilham, B.Sc.

During Sunday, November 26th, the passage of a disturbance of the line-squall type was reported from several of the observing stations. The following particulars were received at the time by telegraph :—

Eskdalemuir.—Squall at 8h. 30m.; temperature fell 9°F. wind changed from NW to N.

Cranwell.—Line squall passed 11h. 45m.

Croydon.—Line squall 15h. 20m.; temperature fell 6°F.; barometer rose 1½mb.; wind veered 6 points; extreme force 5; gust of 33 m.p.h., heavy rain showers.

Biggin Hill.—Line squall 15h. 20m.; temperature fell 6°F.; barometer rose 1½mb.; wind veered 6 points; extreme force 7; heavy rain showers.

According to a detailed report from Eskdalemuir, the passage of the "cold front" was not marked by strong wind. The wind speed shown by the anemometer was only 20 miles per hour and there was no noteworthy gust at the time, though there had been gusts of 40 miles per hour between 6h. and 7h. The increase of pressure, about 0·6 mb. and the change of wind direction took place between 8h. 30m. and 8h. 35m. During these five minutes temperature fell barely half a degree, but a rapid fall, 8·5°F. in 12 minutes, followed. Rain commenced at

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8h. 35m. and continued until 9h. 50m. The amount of rain was 1·9 mm., of which 1·7 mm. fell between 8h. 35m. and 9h. 15m. At the Meteorological Office, Kingsway, the Dines float-barograph showed that pressure decreased steadily at the rate of 0·9mb. per hour until 14h. and remained nearly steady until 14h. 30m. It then rose about 1·3mb. in 2 or 3 minutes and subsequently rose pretty steadily at the rate of 0·8 mb. per hour.

An examination of the synoptic charts shows that a very marked line of discontinuity travelled across the British Isles, approximately from north to south, during the day. The line formed the eastern boundary of a wedge-shaped mass of warm air, with colder air on all sides except the west. Following Bjerknes we will call the northern boundary of the wedge the "cold front" and the southern boundary the "warm front." The phenomena we are interested in occurred as the cold front passed the successive stations.

Fig. 1 reproduces the synoptic chart for 13h. on November 26th, a pecked line indicating the position of the discontinuity. Isobars are drawn at intervals of 2mb. To account for the observed increases of pressure it is necessary to introduce the abrupt discontinuities shown in the isobars. From the fact that Eskdalemuir only experienced half the sudden change observed near London we must conclude that the magnitude of the isobaric discontinuity decreased rapidly towards the west.

Prof. Bjerknes's "polar front" theory involves the assumption that polar air and equatorial air owe their characteristic properties primarily to their source of origin. We should expect to find, therefore, that the warm and cold air on November 26th came from widely different regions. That this was really the case is clear from the trajectories of the air arriving at 13h. at Eskdalemuir (in the cold region) and at London (in the warm region) shown by the full lines in Fig. 2. The cold air had come straight from high northern latitudes, while the warm current can be traced back to an anticyclonic area of indefinite winds which was off our south-west coasts two days earlier. Its previous history is not very clear, but its anticyclonic origin and slow journey over comparatively warm sea probably sufficed to give it the requisite equatorial properties.

The abrupt rise of pressure which accompanied the passage of the cold air shows that the surface of separation must have sloped steeply upwards to a considerable height. This would result in the replacement of a large mass of warm air by the colder and denser air in the course of a minute or two. The depth of the "nose" of polar air concerned in the abrupt rise may be calculated on the assumption that the change of temperature throughout the layer was the same as that measured at the surface. The calculation gives 850 feet for the depth at Eskdalemuir, and 3,300 feet at Croydon. Allowing for the

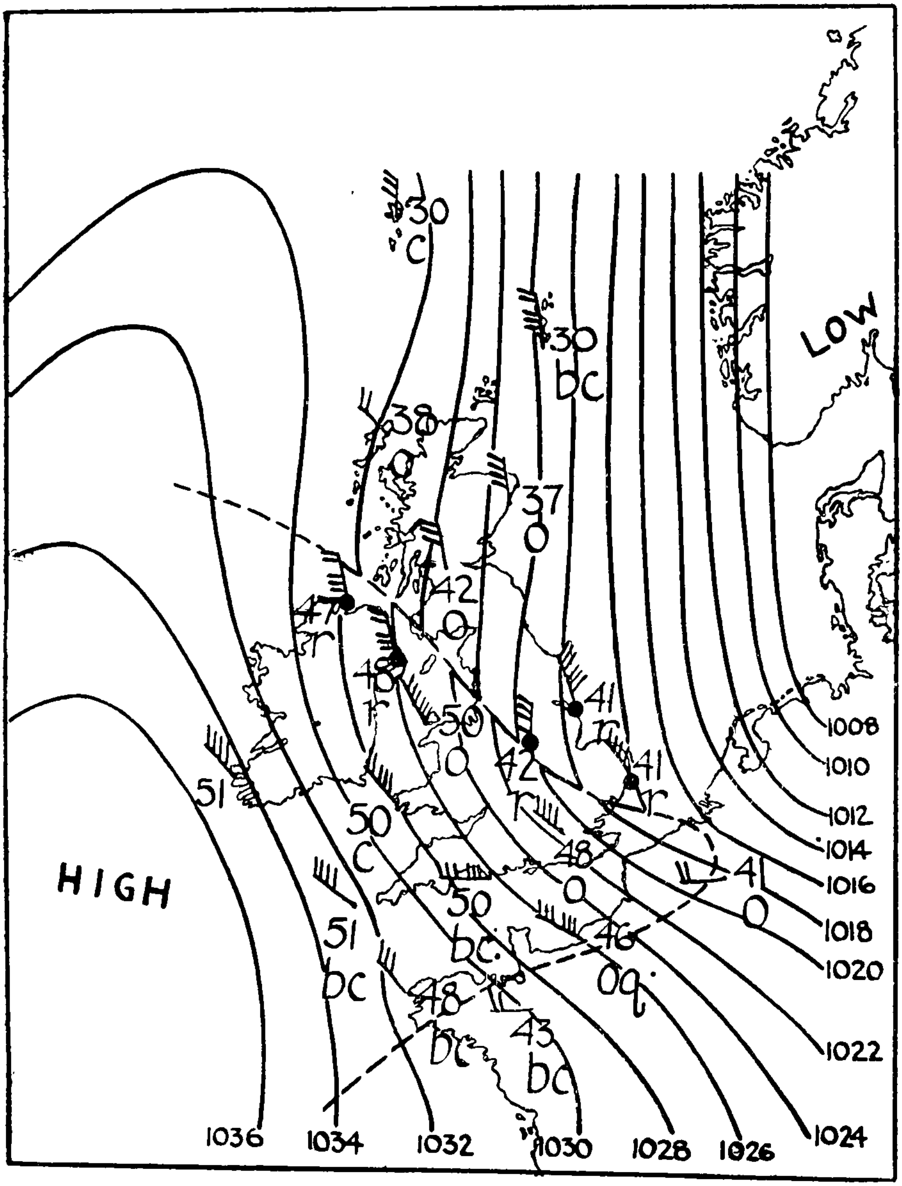
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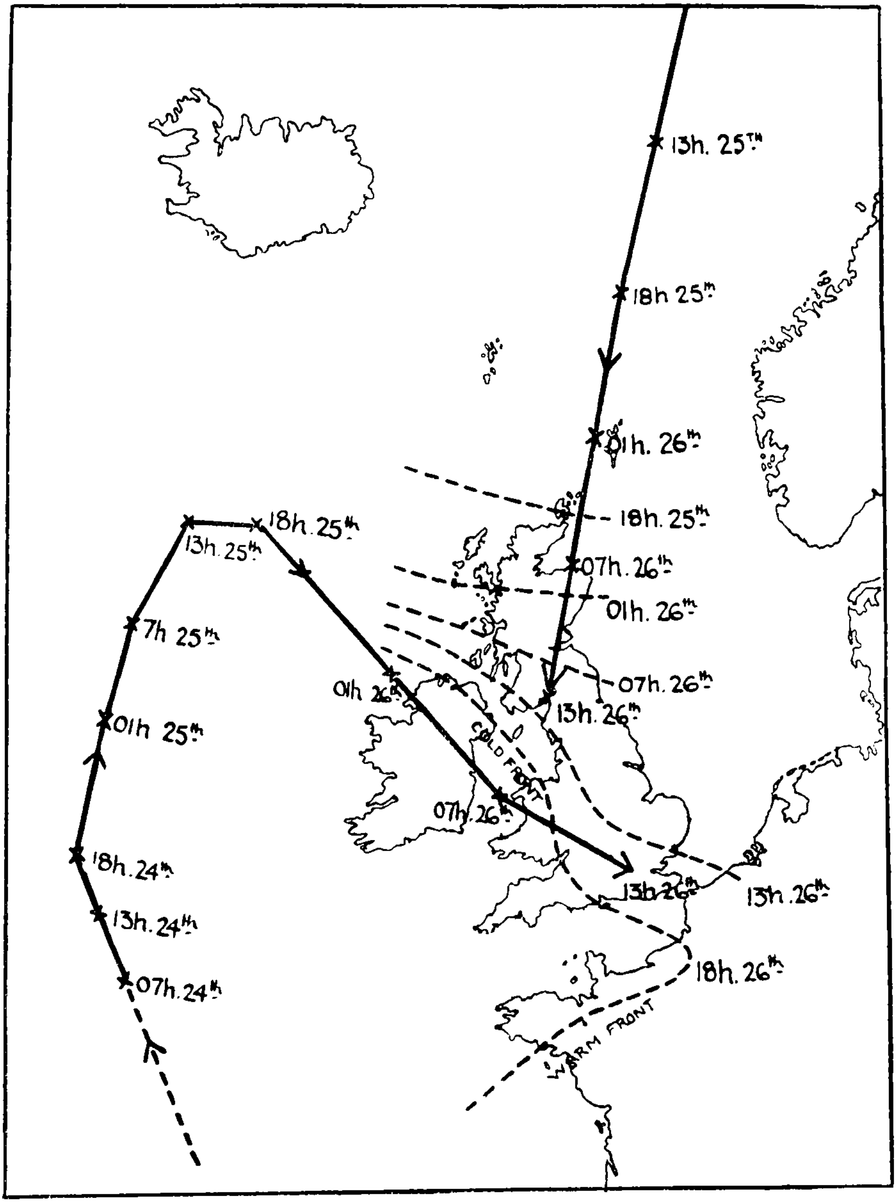
Fig. 1.—Isochronous Chart, 13 h. on Nov. 26th, 1922.

fact that Eskdalemuir is 700 feet above sea level and Croydon only 245 feet, the "nose" appears to have been more than twice as deep at Croydon as at the Scottish station. An aeroplane observation at Leuchars, Fifeshire, at 10h. showed that the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01h 26th
COLD FRONT
07h 26th
18h. 24th
13h. 24th
07h. 24th
13h 26th
13h. 26th
18h. 26th
WARM FRONT

FIG. 2.—Chart showing movements of the cold front and trajectories of the air, Nov. 24th–26th, 1922.

air was cold up to the top of the ascent (6,380 feet); Leuchars was then over a hundred miles behind the cold front, and the polar air probably occupied a depth considerably exceeding 6,000 feet. If the ascent had been high enough to reach the surface of discontinuity, its average slope could have been determined with considerable accuracy.

Fig. 2 shows the position of the cold front at the fundamental observation hours between 18h. November 25th and 18h. November 26th. For the latter hour the warm front is shown as well. The rate of propagation was very irregular, but it was obviously least in the west, where the smallest barometric gradients were found. Between 13h. and 18h. on the 26th, the rate of movement over south-east England was 22 miles per hour towards south-south-west.

It will be seen from Fig. 1 that in this region the gradient wind in front of the squall was inclined about 30°, while the gradient wind behind the squall was inclined about 60° to the cold front. Computing the gradient winds and resolving at right angles to the cold front, we obtain the following results :—

Component of preceding wind in direction of propagation = 25 m.p.h.

Component of following wind in direction of propagation = 26 m.p.h.

These values are in good agreement with the values found for the rate of advance, and imply that there was little horizontal transfer of air across the boundary. That is to say, the system was at that time advancing as a whole without any gain by the polar air at the expense of the equatorial. Under these circumstances there could have been no very violent ascensional movements due to the undercutting of equatorial by polar air, and we would therefore expect little rain. Actually none of the stations in south-east England registered more than a millimetre between 7h. and 18h. on the 26th, though larger falls occurred on the East Anglian coast. It may be remarked, however, that the warm air was comparatively dry and the adiabatic cooling due to a rise of 3,300 feet would have produced only about 1 mm. of rain. The heavier falls on the coast may have been due to the reinforcing of the relatively feeble ascending currents, after the manner recently described* by J. S. Dines.

After 18h. on November 26th, the cold front moved very slowly south-westward and became difficult to identify. In the extreme south-west corner of England the temperature never fell much below 50°F. On the 28th warm air from the west spread over the British Isles again, the temperature rising to above 50°F. in nearly all districts by 13h. on that day.

---

* *Q. J. Roy. Met. Soc.* Oct. 1922.

The Rainfall of 1922.

The few days which elapse between the end of each year and the date when the January number of *The Meteorological Magazine* goes to the printer suffice for only a very hurried scrutiny of the rainfall records for the year.

Several thousand returns have already been received, and from these have been selected only those for which average values are available in order to enable a preliminary idea to be obtained of the relation of the year's fall to the normal. At the moment of writing 280 such records have been examined. It is unfortunately apparent, even at this early date, that the amount of information available for Ireland will be less than usual. A number of extremely valuable old records, long utilized as standards of reference for Irish districts, have come to an end on account of the disturbed conditions. In other parts of the British Isles the data already received are sufficient to yield a fair basis for the construction of a rainfall map.

Dealing first with the rainfall of the individual months of 1922, the following summary shows that the rainfall over the country as a whole was close to or above the average except in the autumn. Fear began to be felt in parts of England lest the slight local deficiency of rain in May and June might herald a resumption of the drought of the previous summer, but excessive rains in July showed these fears to have been groundless.

Monthly General Rainfall as Percentage of Average.

1922.	England and Wales.	Scotland.	Ireland.	British Isles.
January	158	131	126	141
February	148	124	138	138
March	103	76	72	87
April	155	126	136	141
May	57	129	69	83
June	64	102	69	77
July	172	113	112	139
August	132	78	104	109
September	128	87	117	110
October	33	59	37	42
November	55	70	42	56
December	122	86	102	105

During July the total fall was excessive everywhere except in the west of Scotland, whilst locally in England more than twice the average fell. Somewhat similar conditions recurred in August, when great cyclonic rains gave abnormally large totals in the English Midlands. The autumn generally was dry, especially October, when less than a quarter of the average fell in an area stretching from Lancashire to Sussex and including nearly the whole of Wales. The weather conditions during September and October were of the easterly type giving patches of relatively high rainfall on the east coast, but during November and early December the pressure conditions were not unlike those of the summer of 1921, and the fear of a resumption of the drought was probably better justified than at any other time. In December, however, normal winter conditions returned with numerous depressions and excessive rainfall in most parts of England and Ireland.

The most notable feature in the rainfall of the whole year was a belt of excessive fall extending, with some interruptions, from Devonshire and Hampshire northward through the Midlands to Newcastle-on-Tyne. In this tract excesses of 20 per cent. were experienced on Dartmoor, in northern Hampshire, Leicestershire, Nottinghamshire and part of Yorkshire. Another patch of similarly high fall occurred in Norfolk. Except in North Wales, where one or two stations had more than the average, Wales and the west of England, north of the Bristol Channel, had a deficient rainfall. On the east of the central wet belt in England there was slightly less than the average on part of a narrow coastal strip, particularly in the south-east.

In Scotland the conditions were the reverse of those in England. There was a relatively dry belt in the interior with a deficiency of more than 10 per cent., whilst both the east and west coasts showed a tendency to excess, in no case very pronounced.

Of the distribution in Ireland it is difficult to speak with any certainty. There appears to have been an excess in the north and centre, but nearly everywhere else rather less than the normal fell. The most conspicuous deficiency was in a strip extending from Cork to Greenore, culminating in deficiencies of nearly 20 per cent. in the neighbourhood of Dublin.

The general rainfall of the countries as provisionally computed was as follows :—

England	106	Scotland	97
Wales	97	Ireland	94
England and Wales ...	104	British Isles	100

The local wet areas were thus counterbalanced by the larger areas of slight deficiency, the country as a whole having practically the normal fall for the year.

A Summary of the Weather of 1922.

A USEFUL bulletin was issued by the Forecast Division of the Meteorological Office on December 31st, 1922. It consists of two sheets, one a concise account of the weather of 1922, the other a summary of records of temperature, sunshine and rainfall for the year, somewhat on the lines of the Monthly *Supplement to the Daily Weather Report*. The values given are those from a chain of eight stations, stretching from Aberdeen to Falmouth.

The newspapers showed their appreciation of this innovation.

Meteorology at the Science Museum, South Kensington.

THE Board of Education has recently published a catalogue* of the meteorological collection in the Science Museum, South Kensington. The 279 exhibits in the Museum are grouped under appropriate classes and a historical introduction is given for each class. In addition, each exhibit is fully described, and bibliographical references are added where possible. Photographs of a few of the exhibits are also included.

The catalogue is a valuable contribution to meteorology. It is useful to all who study the subject, whether used as a guide to the exhibits or as an independent publication. The comprehensiveness of the catalogue may be gauged from the fact that there are thirty-eight exhibits in the anemometer class, thirty-four in the thermometer class, and that twenty-four patterns of rain-gauge are described.

The historical introductions are worthy of special mention. In the introduction to thermometers it is noted that so long ago as the third century B.C. physicists knew that some relation existed between the temperature and volume of a mass of air, and that descriptions of apparatus which represent the primitive idea of the thermoscope are to be found in writings of that time. There appears to be no mention of the thermometer in literature again until Galileo Galilei wrote some 1,800 years later.

The Tower of the Winds at Athens is mentioned as the earliest known device for locating wind direction. The first weathercock was fitted to a church in the Tyrol in the year 820 A.D. The first mention of an anemometer dates back to 1667, in which year a pressure-plate anemometer of the pendulum type was described in a Royal Society publication. The instrument had been in use some time at that date.

The history of rain-gauges dates back to 1442 when, according to the ancient records of Korea, bronze instruments were constructed. The following extract from the introductory history to rain-gauges gives some indication of the scope of the publication:—

> "In this country the earliest scientific instrument for indicating the rainfall was devised by Sir Christopher Wren about 1662, and was fitted with a tipping bucket, which served as a record. Previously, no special instrument for the local measurement of rainfall had been produced, and the only available evidence was dependent on direct inference, such, for example, as the flood marks of valleys.
>
> "The first records of rainfall were made in Paris by

---

* *Board of Education, Catalogue of the Collections in the Science Museum, South Kensington, with descriptive and historical notes and illustrations.* METEOROLOGY, 9½ × 6, pp. 108, illus. H.M.S.O., 1922. Price 1*s*. 6*d*. net.

> Perrault in 1668, and the first in this country by Townley nine years later. Townley's gauge consisted of a funnel of 12 in. diameter, soldered to a leaden pipe through which the water flowed into convenient vessels, and was weighed. Great care was taken to ensure that the funnel was firmly fixed, and that no rain could trickle down the outside of the funnel into the receiver. The next gauge of which details are available was designed by Hooke and used at Gresham College in 1695. It consisted of a glass funnel of 11·4 in. diameter, mounted on a wooden frame, and leading into a large flask capable of holding about 2 gallons and being provided with a long and narrow neck to minimise evaporation.
>
> "With this apparatus also the collected water was weighed. . . . Two years later Derham, at Upminster, employed a gauge which was similar in principle to Townley's and similarly mounted. As early as 1722 a close approach was made to the modern principle by Horsley in Northumberland, who used a large funnel 30 in. in diameter and 10 in. deep, while a similar apparatus was employed by Abbot Didacus de Revillas at Rome in 1742."

In the introduction to the exhibits classified under " Weather " a concise history of the development of meteorology is given. The history commences with the earliest known journal, kept at Oxford by Rev. William Merle from 1337 to 1344, and concludes with a sketch of the growth of the *Daily Weather Report* up to 1911.

Among the thermometers are a Royal Society's standard thermometer dating from about the latter part of the eighteenth century and a photograph representing five old thermometers by Micheli du Crest, 1754. The thermometer designed for use on aeroplanes brings the thermometer class up to date.

Among the barometers a very fine example of a Diagonal Barometer is shown. " The instrument, which dates from about 1750, is of the type designed by Sir Samuel Morland. In order to obtain an open scale the upper portion of the tube is inclined considerably to the vertical and any change in the barometric pressure is accompanied by a much greater motion of the mercury along the tube than in the case when the barometer tube is vertical.

Mounted on the same board is an alcohol thermometer graduated according to the Fahrenheit scale.

The intervening space is occupied by a calendar entitled " A Perpetual Regulation of Time," from which the days of the month, zodiacal signs, sun's right ascension, declination, and time of rising and setting, high water at London Bridge, and phases of the moon can be ascertained."

Sunshine recorders range from the first spherical lens made by Mr. Campbell, of Islay, for sunshine recording (1857) to Ångstrom's compensated pyrheliometer and Callendar's sunshine receiver, both made by the Cambridge Scientific Instrument Company.

A collection of cloud photographs by Mr. G. A. Clarke illustrates the different types of clouds. Cloud photographs taken from the air by Captain C. K. M. Douglas, R.A.F., give a general indication of the appearance of the types of cloud when viewed from above. The cloud section includes nephoscopes, and allied instruments such as the Darwin-Hill position-finder. The section devoted to "The Atmosphere and its Circulation" contains the anemoidograph designed by Sir Napier Shaw and Sir Horace Darwin for tracing the path of air moving with a definite angular deviation from circular isobars, and a zoetrope arranged by Sir Napier Shaw to illustrate the passage of depressions and the motion of the air.

With reference to the collection itself, it seems unfortunate that the instruments are so arranged that there is no obvious distinction between modern instruments and those of purely historic interest. It is understood that the collection will shortly be moved to the new galleries and it is hoped that advantage will be taken of the opportunity to effect an improvement in the arrangement. At the same time the exhibits will be brought nearer to the Meteorological Office so that they will serve to supplement the display in the Office Library.

M. T. S.

OFFICIAL NOTICES.

Winter Thunderstorms.

CAPTAIN C. J. P. CAVE proposes to continue, in collaboration with the Meteorological Office, the investigation of winter thunderstorms which he has carried out during recent years, and the Director of the Meteorological Office will be much obliged if observers would kindly send to the address given below particulars of any thunder or lightning they may observe from January 1st to March 31st. Captain Cave would be glad to know—

1. Date and time of storm; direction in which it was observed; whether thunder only, lightning only, or both; how long the storm lasted.
2. Whether the storm was severe, or whether there were only one or two claps of thunder, and one or two flashes of lightning.
3. The time when the storm passed overhead, if it did so.
4. Whether there was rain, hail, or snow.
5. If there was much or little wind, and direction of same.
6. In the case of lightning only, seen at night, a particular note of the direction in which it appeared.

Observers may not have the opportunity of noticing all the above particulars, but *any note of the occurrence of thunder or lightning, with any particulars the observer may think worth notice will be extremely useful.*

Notes should be sent by postcard or letter to Capt. C. J. P. Cave, Stoner Hill, Petersfield, and *not* to the Meteorological Office.

Discussions at the Meteorological Office.

December 11th, 1922. *Über den Aufbau hoher Antizyklonen und Zyklonen in Europa.* By F. M. Exner (Met. Zs., Oct., 1921. Transl. in U.S. Monthly Weather Review, Dec., 1921, pp. 653–655).

Opener—Major G. M. Dobson.

The basis of Exner's paper is the work of A. Schedler* in which upper air observations have been classified so as to give the means of pressure and temperature at various heights corresponding with specified pressures at sea level, the cases of rising and falling barometer being distinguished. Exner gives a striking diagram which may be regarded as a cross section through a cyclone and an anticyclone (though, as Sir Napier Shaw mentioned in the discussion, this interpretation must be accepted with caution). It appears that at middle heights the lowest pressure is further east than at the surface, whilst the lowest temperature is further west. At the base of the stratosphere symmetry is restored.

The paper throws some light on the significance of the well-known correlations obtained by Mr. W. H. Dines. Mr. Dines, himself, attaches great weight to the absence of correlation between wind direction and temperature in the upper atmosphere. It is difficult to reconcile the symmetry on which Mr. Dines insists with the asymmetry of Exner's diagram. Major Dobson suggested that in Mr. Dines's work the characteristics of the layers just below the stratosphere predominated, whereas most recent studies had been concerned primarily with the currents at a few thousand feet.

It is clear that there is a great need for sets of simultaneous upper air observations from a close network of stations, and that the observations should extend to the stratosphere. The resulting detailed charts promise to be much more helpful in giving clear ideas of the processes at work than mere statistical investigations.

The subject for discussion on February 5th, 1923, will be a paper on *Cloud Formation* by Dr. C. Braak (K. Mag. en Met. Obs; Verh. No. 10. Batavia, 1922). The discussion will be opened by Dr. J. S. Owens.

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* *Die Beziehungen zwischen Druck und Temperatur in der freien Atmosphäre.* (Beitr. z. Phys. d. fr. Atm. Bd. 9, Heft. 4).

The Royal Meteorological Society.

THE usual monthly meeting of the Society was held on Wednesday, December 20th, Dr. C. Chree, President, in the chair.

C. J. P. Cave, M.A., and R. A. Watson Watt, B.Sc., F.Inst.P. —The study of radio-telegraphic atmospherics in relation to meteorology.

Atmospherics are electro-magnetic waves of low frequency, which manifest themselves in radio-telegraphic receivers as disturbing noises. They are, therefore, a serious hindrance to wireless telegraphy, but they are of great interest to the meteorologist, and were studied many years before commercial radiotelegraphy was practicable. As far back as 1898 it was observed that the approach of a thunderstorm was indicated by atmospherics several hours in advance of the arrival of the more familiar meteorological signs. Later observers found that atmospherics were associated with low pressure, high wind, heavy rainfall, and rapid fluctuations of pressure and temperature. In 1915 radio-telegraphic direction-finding was introduced at South Farnborough, primarily with a view to the issue to aircraft of warnings of approaching line-squalls and thunderstorms. During the years 1916–1920, some twelve of the Coastal Direction-finding Stations of the Admiralty reported "intensity and bearing of atmospherics" at frequent intervals during the day and the reports were collated at South Farnborough. The intersections of bearings greatly helped in the recognition of storms. This method of thunderstorm location has proved very successful, and has been tested over a range of from 5 to 1,000 miles.

In their paper Messrs. Cave and Watt restricted themselves rather scrupulously to the question of the location of thunderstorms by electric waves; the discussion covered a wider range. As was pointed out by Dr. Simpson, there are many ways in which weather conditions affect the transmission of artificial electric waves. The explanation of these effects is of interest to the "wireless" expert; it may prove to be of greater importance to the meteorologist. As to "atmospherics," whilst many are due to lightning and others seem to be associated with "warm front" rain, there is another class which is highly localised and which has not been correlated with meteorological conditions. Captain Slee cited the curious case of Gibraltar, where the reception of wireless messages is generally difficult. It was stated that atmospherics occasionally made communication between ships in the Mediterranean impossible, though the messages which were unintelligible at short range could be picked up in England.

The experimental station at South Farnborough is now maintained by the Radio Research Board, and Mr. Watson Watt, who is still stationed there, is devoting his time to the extension of these important investigations.

C. J. P. Cave, M.A.—Winter thunderstorms in the British Islands.

The results of an investigation into the frequency of winter thunderstorms, carried out by Captain Cave during the first three months of the year in 1916, 1917, 1918 and 1920, are summarized in this paper. Storms occurred somewhere in the British Isles on over 40 per cent. of the days in question, and some of the storms were very widespread. Captain Cave suggested four causes of instability which may result in thunderstorms, (1) the heating of the lower layers of the atmosphere, (2) the cooling of the upper layers, (3) the rising of a warm current over a cold one, and (4) the undercutting of warm air by cold air. He concluded that this last condition, which favours the close proximity in the lower atmosphere of air currents of widely different temperatures, is an important factor in the causation of winter thunderstorms, and that most of the storms in the period examined occurred under such conditions.

An interesting contribution to the discussion of this paper was a letter from Mr. Newnham, who maintained that the differences of temperature in the air currents near the earth's surface, as shown on Captain Cave's maps, were comparatively unimportant and that the principal cause of winter thunderstorms was the warming from below of a current which had come from the polar regions, and passed for great distances over the comparatively warm ocean. In this connection Mr. Brooks mentioned that winter thunderstorms were far more frequent near the west coast of Denmark than further east, evidence which implies that the instability produced over the sea is quickly removed as the air flows over the colder land.

Captain Cave is collecting observations again this winter, and the new information should throw more light on these controversial questions.

D. E. Row—Forecasting Sky-types.

Mr. Row has found that meteorology may be of great service to the artist. Some account of his experience was published in *The Meteorological Magazine* for March 1922. Further details of the methods he uses were described in this paper, and the sketches which were exhibited showed the success he has attained in forecasting sky-types.

Correspondence.

To the Editors, *The Meteorological Magazine.*

Nature Study.

PHENOLOGY is that branch of meteorology which studies the effect of weather conditions upon the seasonal development of animal and plant life. From the late 'seventies, and since 1891, on an uniform systematic plan, the Royal Meteorological Society has issued an annual report on phenology. This report, by collating and co-ordinating the work of a number of observers, mostly amateurs, in the British Isles, is able to present in summary form, supplemented by tables and maps, information of a most valuable botanical, ornithological, and agricultural nature. All that observers are required to do is to note carefully the first appearance of certain birds and insects, twelve in number, and the first blooming of fourteen common plants. Other migrants and notes are asked for, but these are of secondary importance.

Here is a work which should surely appeal to the Nature-lover. By simply recording a few observations on a prescribed form, and forwarding the same promptly about November 15th (the close of the phenological year) to the office of the Society, 49, Cromwell Road, S.W. 7, the work of the amateur is lifted from a purely local value to become a real link in the progress of scientific research.

Stations are still urgently needed in many parts of our islands, and a copy of the observing form will be forwarded upon application to the office of the Society, or to either of the following :—

J. E. CLARK, B.Sc.
41, Downscourt Road, Purley, Surrey.
I. D. MARGARY, M.A.
Chartham Park, East Grinstead, Sussex.

Ball Lightning.

(From *The Times*, December 23rd, 1922.)

THERE was in this locality on December 18th, between 6 and 8 p.m., an extraordinary display of the so-called ball lightning. The phenomenon took the form of balls of bluish, misty flame, which either hovered stationary or darted about the heavens in a curiously irregular manner. Vivid lightning of the ordinary kind accompanied the display, which must have lasted at least two hours. As a close observer of the sky for over fifty years, I have never before witnessed such a spectacle.

LIONEL SMITH-GORDON.
Alderholt Lodge, near Salisbury.

An Observation of Mammato-Cumulus.

A GOOD example of the somewhat rare type of cloud known as mammato-cumulus was to be seen here to-day, December 19th, 1922.

The surface wind was from the south-west, and the cloud under observation was moving slowly from the same direction, its edges sharply defined against the dull sky, except where they merged into trailing curtains of falling rain that mingled with the waters of the Channel. The underside of the massive cloud-bank was heavily festooned with overlapping, balloon-like masses of inky vapour, bulging downwards over the wintry sea. It was a striking sight; threatening and sinister. Very little rain fell inland and the bulging appearance did not last long, gradually fading away into a uniform expanse of slaty-grey. This cloud is often associated with thunderstorms; but, so far as I am aware, such was not the case in the present instance.

ARTHUR BUTCHER.

31, *Beach Street, Deal, December 19th,* 1922.

The Design of Rain-Gauges.

I AM sorry to find my note on the design of rain-gauges, as printed in the December magazine, has by some means been made to say exactly the opposite of what I meant.

I have not my draft at hand, but my intention was to say the high rim of Snowdon or Meteorological Office pattern invariably gives a *lesser* not a larger total for the year.

With 100 more square inches of receiving surface to be wetted there is double the loss of water with the high rim. That may only amount to ·002 in. per day, but with 200 days rain there would be a difference of ·4 in. in addition to the loss in dew. This is not far from what I have found.

J. ELLIS MACE.

View Tower, Tenterden, January 1923.

[It is much regretted that the substitution of "larger" for "lesser" in the printer's copy of Mr. Mace's letter of October 19th was overlooked.—ED. *M.M.*]

An Exceptional Mirage.

An account of a remarkable mirage seen at the Cape Wrath Lighthouse on December 5th, 1922, has been received at the Meteorological Office. The mirage "consisted of the land and sea extending from Dunnet Head to Cape Wrath reflected right across the heavens in a southerly direction . . . . . The mirage appeared precisely as if one was at sea some ten miles off and looking inwards at the original."

NOTES AND QUERIES.

Sleet: A Word with many Meanings.

THE growth of language by the alternate generalization and specialization in the meaning of words is very interesting to the philologist but may be very disconcerting to the workers in other branches of science. An English meteorologist, reading in Humphreys's book on the *Physics of the Air* the following definition of sleet " ice pellets, mere frozen drops (or largely melted snow flakes refrozen)—frozen during the fall of the precipitation through a cold layer of air near the surface of the earth—that rattle when they strike a window, for instance " will not be inclined to accept it without a protest. In fact some discussion of the difference of practice on the two sides of the Atlantic is needed. Fortunately, the Americans have laid their cards on the table, for in the year 1916 the Chief of the Weather Bureau at Washington appointed a Committee " to formulate suggestions of an appropriate nomenclature of sleet " and a lengthy summary of the report of this Committee is printed in the *Monthly Weather Review*.*

The Committee found that the word sleet was used with four distinct meanings in America :—

(*a*) Rain and snow together.
(*b*) " Soft hail " or " graupel."
(*c*) Small particles of clear ice (frozen rain).
(*d*) A coating of ice deposited on twigs, wires, etc.

It was the growth of the popular use of the word sleet in the last of these senses that had made the question urgent, since the havoc due to the weighing down of telegraph wires by ice is a matter of great importance in the United States. The Committee found that this use of the word sleet was generally admitted to be of recent growth and recommended the substitution of " glaze " as the more appropriate term. " Glaze " was preferred to " glazed-frost " (the name adopted officially in this country), since " frost " suggested to many the irregular shapes and the whiteness of hoar-frost rather than the mere presence of frozen water.

It is admitted by the Committee that our use of " sleet " for rain and snow together is in accordance with the earliest English meaning. They give quotations from Murray's Dictionary which take the verb " to sleet " back to 1325, and the noun to 1635 : (" We have sometimes sleet; which is snow and rain together ").

It appears that this usage is not uncommon in America even at the present day, but it has never been adopted there in the official instructions to observers. At any rate from 1850 to 1882, the instructions made sleet the name for graupel. At some date between 1882 and 1897, there was a change in practice and from the latter date the rule has been "only the precipitation that occurs in the form of frozen or partly frozen rain should be called sleet."

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* May 1916, Vol. 44, p. 281.

The Committee concluded by recommending the maintenance of this last definition and slurred over the fact that they were thereby making permanent a divergence from the practice in this country. Their attention does not seem to have been called to the fact that the word was to be found, used in the English sense, in the report of the International Meteorological Committee (Rome, 1913), though not incorporated in a formal resolution.

There is undoubtedly a need for a name for the frozen raindrops which the Weather Bureau calls sleet; they are not the same as graupel, for graupel is white and crumbles between the fingers and differs from the pellets of clear ice under consideration. The German name for these pellets is Eiskörner. Hellmann writes,*—" Eiskörner consist of glass-hard transparent spherules of ice that fall during the cold half of the year. The spherules strike the ground hard like bird-shot, rebound elastically and when they strike the dry foliage make a rather loud noise that at once attracts attention. Often the ice pellets are not round but rather angular or pointed." For such pellets an appropriate name† would be ice-shot. As a suitable symbol, sufficiently like those for hail ▲ and graupel △, we may suggest a triangle with a dot inside it ◬ which is easy to write or to print.

Since 1916, when the Weather Bureau Committee reported, the British use of the word sleet has been accepted by the International Meteorological Conference of 1919 in Paris in the adoption of a special symbol for it and no official protest seems to have been made by those who prefer the American usage.

The same meteorological conference of 1919 took steps, however, towards the publication of an international glossary of meteorological terms and it may be hoped that the question will be cleared up eventually. F. J. W. W.

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* *The Classification of the Hydrometeors.* Trans. in *M. W. Review,* July 1916, Vol. 44, p. 385. Jan. 1917, Vol. 45, p. 13.

† The following note appears in the *Codex of Resolutions adopted at International Meetings, 1872–1907,* by Hildebrandsson and Hellmann (English Edition, M.O. 200, p. 24; German Edition, p. 18) :—

" Small particles of clear ice which are not similar to graupel, are distinguished by the name of 'ice rain' [Eisregen]; a symbol has not been agreed on for this by no means rare phenomenon. As far as the authors know, International Conferences have not, as yet, discussed this point."

Radiation from the Sky.

In the table printed below the means of the various determinations of radiation at Benson during 1922 are set out.

Comparison with the corresponding table for 1921 (*The Met. Mag.*, Jan. 1922, p. 366) shews that the "dark heat" from the atmosphere at the times of the observations was less in 1922 than in 1921 by about 4 per cent. The most striking difference is in the diffuse solar radiation which was lower by over 30 per cent. In May 1921, the value of J_0 was 75, while the highest value for 1922 was 37. In the case of J_1, the maxima for the two years were 250 in June 1921 and 155 in July 1922.

RADIATION MEASURED AT BENSON, OXON, 1922.

Unit : one gramme calorie per square centimetre per day.

ATMOSPHERIC RADIATION only (dark heat rays).

Averages for Readings about time of Sunset.

		Oct.	Nov.	Dec.	Year.
Cloudless days :—					
Number of readings - -	n	20	15	8	...†
Radiation from sky in zenith	πI	471	448	470	480
Total radiation from sky - -	J	502	479	500	515
Total radiation from horizontal black surface on earth.	X	701	637	661	702
Net radiation from earth - -	$X—J$	199	158	161	187

DIFFUSE SOLAR RADIATION (luminous rays).

Averages for Readings between 9 h. and 15 h. G.M.T.

		Oct.	Nov.	Dec.	Year.
Cloudless days :—					
Number of readings - -	n_0	7	6	3	...*
Radiation from sky in zenith - -	πI_0	23	18	14	25
Total radiation from sky -	J_0	38	28	24	34
Cloudy days :—					
Number of readings -	n_1	8	7	10	...†
Radiation from sky in zenith -	πI_1	105	47	32	90
Total radiation from sky -	J_1	89	40	23	76

Unit for I = gramme calorie per day per steradian per square centimetre.

Unit for J and X = gramme calorie per day per square centimetre.

For description of instrument and methods of observation, see *The Meteorological Magazine*, October, 1920, and May, 1921.

† Mean of 12 monthly averages.

* ,, 11 ,, ,, (July missing).

A Correction.

For the values of diffuse solar radiation at Benson on cloudy days in April, May and June (*The Met. Mag.*, Sept. 1922, p. 220), *read* :—

		April.	May.	June.
Cloudy days :—				
Number of readings - -	n_1	8	9	10
Radiation from sky in zenith -	πI_1	102	75	94
Total radiation from sky -	J_1	85	65	83

The Buys Ballot Medal 1923.

Award to Sir Napier Shaw.

It is announced that the Buys Ballot Medal has been awarded by the Royal Academy of Science at Amsterdam to Sir Napier Shaw, F.R.S., Professor in the Royal College of Science, late Director of the Meteorological Office. The medal was founded in 1888 in commemoration of the work of C. H. D. Buys Ballot, the famous meteorologist of the Netherlands, to be awarded every tenth year to the person who is judged to have made the most valuable contributions to the science of meteorology. The award to Sir Napier Shaw is made for his contributions to all branches of the science, and especially for his work as President of the International Meteorological Committee. The previous awards were : 1893, Dr. Julius Hann of Vienna ; 1903, Dr. R. Assmann and Dr. A. Berson of Berlin, jointly ; 1913, Dr. H. Hergesell of Strasbourg.

Meteorology in the South Orkneys.

In March, 1923, a fine series of observations from the South Orkneys will be available, for that month will complete 20 years of uninterrupted hourly eye-observations. The series will be valuable for the computing of normals and of correlation coefficients. News is also received that the Argentine Minister of Marine has decided to equip a proper Polar ship to effect the annual relief of the staff at the South Orkneys and to carry out explorations and hydrographic work in general.

British Association : Meeting at Hull, 1922.

An account of the discussion on " Weather Cycles in Relation to Agriculture and to Industrial Fluctuations "which was mentioned in this magazine, October, 1922, p. 239, is published in *Nature*, December 30th, 1922, p. 889. The discussion was opened by Sir William Beveridge and continued by Mr. R. A. Fisher, Dr. G. C. Simpson, Mr. Udny Yule and Professor H. H. Turner.

Distributive Stations of the Meteorological Office.

A LIST of the Distributive Stations of the Meteorological Office and their Auxiliary Reporting Stations as at present established is given below.

The Stations at Pulham and Felixstowe were closed on April 10th, 1922,† and that at Collinstown, which had been transferred from Baldonnell on April 28th, 1922, on October 25th, 1922. The Station at Manchester was reopened on a temporary basis on October 25th, 1922.

This list supersedes that given in the Meteorological Magazine, January, 1922, p. 351.

The various types of stations are indicated by the letters in the first column.

Type.	County.	Station.	Lat.		Long.		Height above M.S.L.	Officer in Charge.
			°	′	°	′	Ft.	
R	Fifeshire	Leuchars	56	23	2	52 W.	40	W. Gillon.
C	Renfrewshire	Renfrew -	55	52	4	24 W.	36	J. J. Somerville.
U	Yorkshire -	Flamborough Head.	54	7	0	5 W.	150	Coastguard.
A	Anglesey	Holyhead	53	19	4	37 W.	26	J. D. Ashton.
R	Flintshire	Shotwick - -	53	13	3	0 W.	16	H. F. Jackson.
C	Lancashire	Manchester -	53	26	2	15 W.	98	J. A. Watson.
RI	Lincolnshire	Cranwell	53	2	0	31 W.	236	W. H. Pick.
R	Devonshire -	Cattewater -	50	22	4	8 W.	82	W. L. Andrew.
R	Hampshire	Andover	51	13	1	31 W.	295	G. H. L. Douglas-Lane.
RI	Hampshire	Calshot -	50	49	1	17 W.	10	J. Durward.
RR	Hampshire	South Farnborough.	51	17	0	46 W.	230	R. M. Stanhope.
C	Surrey	Croydon	51	21	0	7 W.	244	G. R. Hay.
U	Kent	Biggin Hill	51	19	0	2 E.	600	D. F. Bowering.
RR	Kent	Isle of Grain	51	27	0	43 E.	20	H. St. G. Dyke-Marsh.
C	Kent	Lympne	51	5	1	1 E.	349	R. S. Read.
U	Kent - -	Hythe	51	3	1	5 E.	5	Coastguard.
U	Sussex	Beachy Head	50	44	0	15 E.	525	Coastguard.
U	Kent - -	North Foreland	51	22	1	27 E.	188	Officer, i/c. P.O. Wireless Station.
U	Kent	Deal -	51	13	1	24 E.	20	Coastguard.

C.—Civil Aerodrome.
R.—Royal Air Force Station.
RI.—Royal Air Force Station (Regular Lectures and Instruction given in Meteorology).
RR.—Royal Air Force Station (associated with Research or Design).
A.—Experimental Anemometrical Station.
U.—Auxiliary Observing Station.

† Observations ceased March 31st, 1922.

Reviews.

La Maxima de la Radiacion Solar en Enero y Febrero de 1920 y el Estado del Tiempo Mundial. By H. H. Clayton and Guillermo Hoxmark. 12½ × 10, pp. 16, 9 diagrams. Buenos Aires: Oficina Meteorologica Argentina, 1922.

THIS paper deals with the departures from the normal of pressure, temperature and rainfall over the earth's surface during the months of January and February, 1920, when, as shown by the observations made by the Astrophysical Observatory of the Smithsonian Institution at Calama, Chile, there was a marked maximum in solar radiation. In January, 1920, the mean value of the solar radiation was 1·964 gram calories per square centimetre, which was 1 per cent. greater than in 1919.

For determining the solar influence, two sets of comparisons were made for each of the months under review: the mean values of the principal elements of the climate were compared with those of the same months of the previous year when a normal value of solar radiation was recorded, and were also compared with the normals based on a long series of years.

It was found that the increased solar radiation in January, 1920, was associated with an increase in the normal atmospheric circulation. Barometric pressure was under the average in that part of the earth directly under the sun, *viz.*, from the equator to lat. 30°N and S, while pressure was above the average between lat. 40° and 50° in both hemispheres, with a marked deficiency in the neighbourhood of the Polar circles.

Temperature between lat. 40° N and 40° S, was at the same time slightly under the average, but in high latitudes there was an increase. The influence on the rainfall was difficult to determine on account of local irregularities, but was found to be above the average in the circumpolar low pressure belts between lat. 60° and 70° and also in the tropics, especially from 10° to 30° S, where the sun in January is overhead. On the other hand, there was a diminished rainfall in the high pressure belts between lat. 30° and 50° north and south.

February, 1920, was discussed in a similar way, and it was seen on comparing the results with those of January that there was a progressive movement of the centres of disturbances following solar activity. For example, the pressure centre of greatest excess in North America in January had, in February, moved southward from north-west Canada to the north-western States, and the January zone of deficient pressure near Iceland had moved north-east to Spitsbergen. The deficiency of temperature in Canada had progressed eastward to the east coast of the United States and the western North Atlantic, while the north-west of the States and Canada had been overspread by a " warm wave." The high January temperature over western Europe had in the succeeding month become even more pronounced and extensive, and now embraced Finland.

It is clearly shown that an increase of solar radiation intensifies the normal pressure distribution, bringing about a more active circulation, so that temperature and rainfall are deficient, especially in middle and high latitudes where winds with a Polar component (of motion) prevail. On the other hand, where winds with an equatorial component were experienced, rainfall and temperature were above the normal. Within the tropics the surface air temperature was found to decrease and the rainfall to increase with the more vigorous atmospheric circulation in higher latitudes. The paper is illustrated by nine diagrams, giving " world " results in graphic form, and a table shows departures from the normal for pressure temperature. and rainfall during January and February, 1920, for 141 stations, the abnormals being grouped in 10° squares in a second table. This paper is an important extension of Mr. Clayton's previous investigations on the effect of short period variations of solar radiation on the Earth's atmosphere.

R.C.M.

Rainfall in the Southern Pennines, Vol. I., No. 10, *Annual Summary, 1919*. By A. A. Barnes, 9 × 10½, pp. 191, 2 maps. Manchester and Stockport Rainfall Organisation, 1922.

WE note with pleasure that the useful summaries of rainfall in the Southern Pennines, prepared by Mr. A. A. Barnes for the Manchester and Stockport Rainfall Organisation, are being continued, and trust that the arrears in publication caused by the war will soon be made up.

Although Mr. Barnes deals with the distribution of rainfall more or less on the lines already made familiar in *British Rainfall*, so that the data now presented are in some respects repetitions of those already published, the work is fully justified since its concentration on a particular area enables a great amount of detail to be introduced. The district, which includes about 3,750 square miles, extending from Blackpool to Crewe and from Hoylake to Chesterfield, is in some respects the most important in the country from the point of view of rainfall, since it is the source of the water supplies of practically all the great industrial areas of the north.

The summary before us deals with the year 1919, and is of peculiar interest on account of the fact that the area dealt with happens to include portions both of the English Midlands, for which the year was a very wet one, and of the north-western Pennines, for which it was very dry, so that the range of rainfall was abnormally great.

The Weather of December, 1922.

At the beginning of December an anticyclone was situated over the Bay of Biscay, and this high pressure area maintained its position with little change for the first week or so of the month. During this period westerly winds with mild weather prevailed over the British Isles. There was little rain in the southern districts, but further north, the weather was affected by Atlantic depressions, and there were occasional gales on the coast. A depression in the neighbourhood of the Azores gave 48mm. of rain at Ponta Delgada on the 2nd. On the 7th, a depression over Germany was associated with snow at many places in Germany and Poland, and locally in Denmark. This depression moved away south-eastward, causing unsettled weather with snow and a low temperature over Central Europe, where for some days temperature did not rise above freezing point. On the 8th, further heavy rain fell at the Azores, 42mm. being measured at Horta. By this date the high pressure area to the south and west of the British Isles, stretched from Madeira to Iceland. On the 9th, its central portion covered the British Isles. On the 11th, it was over France and Spain, and it remained over France until the 13th, giving fair quiet weather over south-western Europe.

The Atlantic depressions now began to take a more southerly course, and up to the end of the month the weather of west and north-west Europe was stormy and unsettled. During the latter half of the month, Altantic liners crossing between Europe and America reported gales of an unusually severe and protracted character. A deep depression approached the British Isles and by the evening of the 18th, was centred off the Hebrides. South to south-west gales occurred on the British coasts, and on this day thunderstorms were experienced at various places in the British Isles. In the early hours of the morning of the 20th, an intense secondary depression with a separate circulation appeared at the mouth of the Channel and moved north-eastwards, causing gales and heavy rain over southern England and northern France. At Plymouth, 41mm. of rain fell during the night of the 19th–20th. In the rear of this secondary sleet and snow fell in Scotland and parts of England.

A very large low-pressure area still remained over the Atlantic maintaining very unsettled weather in western Europe. On the morning of the 21st, an exceptionally deep depression, with pressure near its centre as low as 952mb., appeared off the west of Ireland, and as it moved north-eastwards there was a renewal of gales in the British Isles, the English Channel and Scandinavia. A secondary depression associated with it crossed southern England, giving heavy rain and thunderstorms, particularly in the western districts.

On the morning of the 25th, another large depression appeared

(*Continued on p.* 350.)

Rainfall Table for December 1922.

STATION.	COUNTY.	Aver. 1881—1915.	1922.		Per cent. of Av.	Max. in 24 hrs.		No of Rain Days.
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	2·39	3·14	80	131	·63	21	18
Tenterden (View Tower)	*Kent*	3·11	2·80	71	90	·72	21	17
Arundel (Patching Farm)	*Sussex*	3·36	3·59	91	107	·71	30	13
Fordingbridge (Oaklands)	*Hampshire*	3·96	4·67	119	118	·99	21	18
Oxford (Magdalen College)	*Oxfordshire*	2·32	2·50	63	108	·50	19	15
Wellingborough (Swanspool)	*Northampton*	2·35	2·62	67	111	·56	21	19
Hawkedon Rectory	*Suffolk*	2·42	1·67	42	69	·32	21	16
Norwich (Eaton)	*Norfolk*	2·61	2·68	68	103	·44	23	19
Launceston (Polapit Tamar)	*Devon*	5·12	6·91	175	135	1·57	19	26
Sidmouth (Sidmount)	,,	3·93	4·94	126	126	1·19	19	21
Ross (County Observatory)	*Herefordshire*	2·97	4·07	103	137	1·21	19	17
Church Stretton (Wolstaston)	*Shropshire*	3·36	4·57	116	136	1·27	19	22
Boston (Black Sluice)	*Lincoln*	2·15	2·72	69	127	·52	20	21
Worksop (Hodsock Priory)	*Nottingham*	2·36	3·04	77	129	·60	19	19
Mickleover (Clyde House)	*Derbyshire*	2·63	3·78	96	144	·96	19	19
Southport (Hesketh Park)	*Lancashire*	3·23	4·10	104	127	·66	29	23
Wetherby (Ribston Hall)	*York, W. R.*	2·45	4·58	116	187	1·86	20	12
Hull (Pearson Park)	,, *E. R.*	2·41	2·26	57	94	·58	20	21
Newcastle (Town Moor)	*North'land*	2·41	3·55	90	147	1·10	20	16
Borrowdale (Seathwaite)	*Cumberland*	16·34	18·45	469	113	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	5·11	7·89	200	154	1·50	19	16
Haverfordwest (Gram. Sch.)	*Pembroke*	5·70	5·67	144	99	·84	21	23
Aberystwyth (Gogerddan)	*Cardigan*	5·03	4·79	122	95	·85	14	9
Llandudno	*Carnarvon*	3·10	4·33	110	140	1·22	30	22
Dumfries (Cargen)	*Kirkcudbrt.*	5·41	5·56	141	103	1·09	22	21
Marchmont House	*Berwick*	2·81	2·74	70	98	·56	29	19
Girvan (Pinmore)	*Ayr*	5·99	3·96	101	66	·52	21	23
Glasgow (Queen's Park)	*Renfrew*	4·23	3·11	79	74	·60	25	21
Islay (Eallabus)	*Argyll*	5·93	4·57	116	77	·61	28	26
Mull (Quinish)	,,	7·13	7·12	181	100	1·05	22	26
Loch Dhu	*Perth*	10·08	8·90	226	88	1·55	25	23
Dundee (Eastern Necropolis)	*Forfar*	2·66	1·87	47	70	·56	16	19
Braemar (Bank)	*Aberdeen*	3·56	3·56	90	100	·88	22	17
Aberdeen (Cranford)	,,	3·48	2·50	63	72	·36	18	18
Gordon Castle	*Moray*	2·69	1·44	37	54	·33	30	12
Fort William (Atholl Bank)	*Inverness*	10·15	9·68	246	95	2·03	12	26
Alness (Ardross Castle)	*Ross*	4·13	3·75	95	91	·59	22	22
Loch Torridon (Bendamph)	,,	10·20	10·74	273	105	1·62	12	25
Stornoway	,,	6·25	5·88	149	94	·77	5	25
Loch More (Achfary)	*Sutherland*	9·24	9·56	243	103	1·36	5	26
Wick	*Caithness*	3·08	2·38	61	77	·44	23	24
Glanmire (Lota Lodge)	*Cork*	5·50	4·50	114	82	·57	13†	23
Killarney (District Asylum)	*Kerry*	7·28	..	..	..	·97	21	..
Waterford (Brook Lodge)	*Waterford*	4·69	3·61	92	77	·76	15	17
Nenagh (Castle Lough)	*Tipperary*	4·61	6·50	140	119	·77	15	26
Foynes	*Limerick*	4·73	6·21	158	131	·55	16	25
Gorey (Courtown House)	*Wexford*	3·82	2·42	61	63	·43	22	19
Abbey Leix (Blandsfort)	*Queen's Co.*	3·68	4·53	115	123	1·25	15	22
Dublin (FitzWilliam Square)	*Dublin*	2·48	1·81	46	73	·32	13	19
Mullingar (Belvedere)	*Westmeath*	3·68	4·46	113	121	·94	15	24
Crossmolina (Enniscoe)	*Mayo*	6·55	..	..	..	..	..	..
Collooney (Markree Obsy.)	*Sligo*	4·73	5·18	132	109	·94	23	23
Seaforde	*Down*	4·12	4·59	117	111	·75	21	18
Ballymena (Harryville)	*Antrim*	4·44	3·58	91	81	·76	16	24
Omagh (Edenfel)	*Tyrone*	4·23	5·36	136	127	·70	22‡	24
Letterkenny Asylum	*Donegal*	5·35	5·84	148	109	·76	23	24

† *and* 21. ‡ *and* 23.

Supplementary Rainfall, December 1922.

Div.	STATION.	RAIN. in.	RAIN. mm.	Div.	STATION.	RAIN. in.	RAIN. mm.
II.	Ramsgate	2·12	54	XII.	Langholm, Drove Rd.	5·86	149
,,	Sevenoaks, Speldhurst	3·91	99	XIII.	Ettrick Manse	6·80	173
,,	Tottingworth Park...	3·86	98	,,	North Berwick Res....	1·63	41
,,	Totland Bay, Aston Ho.	4·41	112	,,	Edinburgh, Royal Ob.	2·68	68
,,	Ashley, Old Manor Ho.	4·15	105	XIV.	Biggar...............	3·00	76
,,	Grayshott...........	5·39	137	,,	Leadhills	8·02	204
,,	Ufton Nervet........	3·00	76	,,	Kilmarnock, Agric.Coll.	3·56	91
III.	Harrow Weald, Hill Ho.	2·62	67	XV.	Dougarie Lodge.......	3·27	83
,,	Pitsford, Sedgebrook..	2·60	66	,,	Oban................	5·52	140
,,	Chatteris, The Priory.	1·81	46	,,	Inveraray Castle......	8·40	213
IV.	Elsenham, Gaunts End	2·07	53	,,	Mull, Benmore	11·40	290
,,	Lexden, Hill House ..	1·77	45	XVI.	Loch Venachar	6·00	152
,,	Aylsham, Rippon Hall	2·69	68	,,	Gleneagles House	4·80	122
,,	Swaffham...........	2·38	61	,,	Loch Rannoch, Dall...	6·40	163
V.	Devizes, Highclere ...	3·85	98	,,	Blair Atholl..........	3·98	101
,,	Weymouth..........	4·54	115	,,	Coupar Angus........	2·22	56
,,	Ashburton, Druid Ho.	9·85	250	,,	Montrose Asylum	1·73	44
,,	Cullompton	6·09	155	XVII.	Logie Coldstone, School	2·13	54
,,	Hartland Abbey	5·56	141	,,	Fyvie Castle..........	1·89	48
,,	Penzance, Morrab Gden.	7·42	188	,,	Grantown-on-Spey ...	1·86	47
,,	St. Austell, Trevarna.	7·97	202	XVIII.	Kingussie, Fasnakyle..	3·47	88
,,	Crewkerne Merefield Ho	5·34	136	,,	Fort Augustus........	6·92	176
VI.	Clifton College	5·61	143	,,	Loch Quoich, Loan ...	16·30	414
,,	Ledbury, Underdown.	3·88	99	,,	Faire-na-Squir........	6·74	171
,,	Shifnal, Hatton Grange	4·15	105	,,	Skye, Dunvegan	7·47	190
,,	Ashbourne, Mayfield.	4·71	120	,,	Fortrose	1·38	35
,,	Barnt Green, Upwood	3·14	80	,,	Ullapool	4·97	126
,,	Blockley, Upton Wold	4·24	108	XIX.	Dornoch, St. Gilbert's .	1·23	31
VII.	Leicester, TownHallSq.	3·12	79	,,	Tongue Manse	3·33	85
,,	Grantham, Saltersford	3·31	84	,,	Melvich Schoolhouse ..	3·01	77
,,	Louth, Westgate	2·94	75	XX.	Castletownshead......	5·11	130
,,	Mansfield, West Bank	3·85	98	,,	Dunmanway Rectory..	7·50	191
VIII.	Nantwich, Dorfold Hall	4·95	126	,,	Gearahameen	15·80	401
,,	Bolton, Queen's Park.	6·40	163	,,	Darrynane Abbey	5·69	145
,,	Lancaster, Strathspey.	5·12	130	,,	Cashel, Ballinamona...	4·32	110
IX.	Wath-upon-Dearne...	3·09	79	,,	Roscrea, Timoney Park	4·91	125
,,	Bradford, Lister Park.	3·54	90	,,	Broadford, Hurdlestown	6·70	170
,,	West Witton.........	5·38	137	XXI.	Kilkenny Castle.......	3·79	96
,,	Scarborough, Scalby..	3·29	84	,,	Rathnew, Clonmannon	2·54	65
,,	Middlesbro', Albert Pk.	3·48	88	,,	Hacketstown Rectory .	2·96	75
,,	Baldersdale, Hury Res.	5·07	129	,,	Balbriggan, Ardgillan .	2·45	62
X.	Bellingham	4·23	107	,,	Drogheda	2·71	69
,,	Ilderton, Lilburn	3·20	81	,,	Moate, Coolatore......	3·76	95
,,	Orton...............	9·28	236	XXII.	Castle Forbes Gdns....	4·27	109
XI.	Llanfrechfa Grange ..	..	..	,,	Galway, Grammar Sch.	..	..
,,	Treherbert, Tyn-y-waun	13·47	342	XXIII.	Westport House	7·71	196
,,	Carmarthen Friary ..	5·39	137	,,	Aasleagh House	11·78	299
,,	Lampeter, Falcondale	6·16	157	,,	Enniskillen, Portora...	4·23	107
,,	Cray Station	9·30	236	,,	Crossdoney, Kevit Cas.	4·29	109
,,	B'ham W.W., Tyrmyndd	7·46	189	,,	Armagh Observatory ..	2·97	75
,,	Lake Vyrnwy.......	8·46	215	,,	Warrenpoint	3·64	93
,,	Llangynhafal, P. Drâw	4·38	111	,,	Belfast, Cave Hill Rd..	3·45	88
,,	Oakley Quarries	..	..	,,	Glenarm Castle	3·47	88
,,	Dolgelly, Bryntirion..	6·80	173	,,	Londonderry, Creggan.	4·00	102
,,	Snowdon L., Llydaw 9	25·87	657	,,	Sion Mills............	4·47	113
,,	Lligwy	5·43	138	,,	Milford, The Manse ...	4·71	120
XII.	Stoneykirk, ArdwellHo	2·98	76	,,	Narin, Kiltoorish	7·25	184
,,	Carsphairn, Shiel.....	8·00	203	,,	Killybegs, Rockmount .	7·50	191

Correction—Darrynane Abbey, November, *for* "3·50 \| 39," *read* "3·50 \| 89."

Climatological Table for the

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean of Day M.S.L. mb.	Diff. from Normal mb.	Max. ° F.	Date	Min. ° F.	Date	Max. ° F.	Min. ° F.	½ max. and min. ° F.	Diff. from Normal ° F.
London, Kew Obsy.	1013·3	−2·2	76	21	46	4	66·6	51·7	59·1	−3·6
Gibraltar	1017·6	+2·3	88	8, 31	61	2	81·7	66·7	74·2	−0·5
Malta	1016·0	+2·0	89	16	67	4, 28	82·2	70·8	76·5	−1·0
Sierra Leone,	1015·5	+2·1	87	16	72	sev.	82·0	74·0	78·0	−1·0
Lagos, Nigeria	1013·8	0·0	86	30	70	14	81·8	73·1	77·5	+0·2
Kaduna, Nigeria	1012·7	−1·3	83	3	60	26	78·2	66·1	72·1	−2·5
Zomba, Nyasaland	1019·6	+1·7	78	22, 23, 28	48	17	72·7	53·4	63·1	+1·4
Salisbury, Rhodesia	1020·0	−0·9	79	24	34	4	71·5	41·1	56·3	+0·2
Cape Town	1021·8	+0·5	79	12	38	25	63·6	48·4	56·0	+1·1
Johannesburg	1024·6	+0·5	70	31	36	12	63·0	42·5	52·7	+2·1
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	..	..	69	27	27	21	63·6	32·3	47·9	+0·6
Calcutta, Alipore Obsy.	998·1	−1·1	93	4	75	27	88·8	79·2	84·0	+0·5
Bombay	1003·4	−0·3	87	10	75	5	83·8	77·3	80·5	−0·6
Madras	1004·1	−0·4	104	6	74	19, 20	97·1	79·0	88·1	+0·8
Colombo, Ceylon	1010·0	+1·9	87	31	71	1, 2	84·7	76·1	80·4	−0·9
Hong Kong	1004·4	−0·5	91	1	73	12	87·3	78·6	82·9	+0·4
Sandakan	..	..	90	3, 25, 29	73	4	88·2	75·4	81·8	−0·1
Sydney	1015·8	−2·7	66	6, 22	39	1	62·0	46·5	54·3	+1·9
Melbourne	1016·4	−2·7	66	31	35	3, 4	57·0	43·0	50·0	+1·4
Adelaide	1017·2	−3·2	68	30	37	25	58·7	44·6	51·7	+0·1
Perth, W. Australia	1017·7	−1·4	68	9	37	15	61·1	45·6	53·3	−1·8
Coolgardie	1019·3	−0·6	69	27	32	15	58·7	39·6	49·1	−2·1
Brisbane	1016·8	−1·5	71	30	39	10	66·5	48·2	57·2	−1·0
Hobart, Tasmania	1016·4	+2·6	60	31	34	3, 25	53·6	41·5	47·5	+2·1
Wellington, N.Z.	1019·5	+6·6	59	11	31	31	54·2	41·8	48·0	+0·5
Suva, Fiji	1014·0	−0·2	85	31	62	26, 28	79·7	67·1	73·4	−0·2
Kingston, Jamaica	1015·6	+0·9	93	12	71	6	90·6	73·6	82·1	+0·4
Grenada, W.I.	1015·2	+1·9	88	31	71	27	83·9	74·3	79·1	+0·2
Toronto	1015·7	+1·6	87	11	50	6	79·9	59·2	69·5	+1·3
Winnipeg	1013·3	+0·6	89	14, 20	41	7	77·7	54·7	66·2	0·0
St. John, N.B.	1016·5	+2·8	77	31	47	10	66·4	53·6	60·0	−0·4
Victoria, B.C.	1018·8	+2·1	87	2	47	30	67·0	50·6	58·8	−1·5

London, Kew Observatory.—Prevailing wind direction WSW, mean speed 7·9 mi/hr.

Gibraltar.—Prevailing wind direction E. Corrected pressure values and diffs. from normal: Mar., 1018·6+2·8, Apr., 1018·7+3·4, May, 1019·0+4·1, June, 1016·6+0·8 mb.

Malta.—Prevailing wind direction NW.

Sierra Leone.—Prevailing wind direction SW, 3 days with thunder heard.

Lagos, Nigeria.—Prevailing wind direction SW.

Salisbury, Rhodesia—Prevailing wind direction easterly.

Madras.—Corrected pressure values and diffs. from normal: Jan., 1013·0, −1·1, Feb., 1012·1, −0·8, Mar., 1010·0, −0·9, Apr., 1007·8, −0·6, May, 1005·0, −0·4, June, 1003·3, −0·5 mb.

Mauritius :—										
January 1922	1007·1	−4·8	89	4	67	2	84·9	73·0	79·0	−0·3
February ,,	1007·0	−4·0	88	23, 24	66	2	85·3	73·0	79·2	−0·1
March ,,	1012·6	+0·6	88	10	69	8, 16	85·5	73·0	79·3	+1·3
April ,,	1013·8	−0·2	88	1	59	30	80·2	68·2	74·2	−1·6

British Empire, July 1922.

TEMPERATURE Mean Wet Bulb. °F.	TEMPERATURE Absolute Min. on Grass °F.	Relative Humidity %	Mean Cloud Am'nt 0–10	PRECIPITATION Amount in.	PRECIPITATION Amount mm.	PRECIPITATION Diff. from Normal mm.	PRECIPITATION Days	BRIGHT SUNSHINE Hours per day	BRIGHT SUNSHINE Percentage of possible	STATIONS
55·6	36	72	7·3	3·30	84	+ 29	20	4·9	30	London, Kew Obsy.
66·9	58	70	2·4	0·00	0	– 1	0	..	..	Gibraltar.
69·6	64	67	0·3	0·00	0	– 1	0	11·7	82	Malta.
73·8	..	83	8·8	37·68	957	+ 81	29	..	..	Sierra Leone.
73·9	69	79	8·6	2·75	70	– 199	4	..	..	Lagos, Nigeria.
67·6	..	80	1·0	10·35	263	+ 31	14	..	..	Kaduna, Nigeria.
..	..	78	3·5	0·38	10	+ 3	4	..	..	Zomba, Nyasaland.
49·5	..	55	1·5	0·03	1	0	2	..	..	Salisbury, Rhodesia.
52·6	..	78	5·9	2·33	59	– 31	13	..	..	Cape Town.
42·1	28	58	0·6	0·00	0	– 6	0	10·0	94	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
36·4	..	70	2·3	0·00	0	– 10	0	..	..	Bloemfontein.
80·9	74	80	9·1	14·50	368	+ 41	*14	..	..	Calcutta, Alipore Obsy.
77·1	65	84	8·9	31·00	787	+ 148	*30	..	..	Bombay.
76·0	73	59	7·7	3·22	82	– 22	*15	..	..	Madras.
77·0	70	76	9·0	2·71	69	– 61	10	..	..	Colombo, Ceylon.
78·0	..	81	5·8	12·80	325	+ 6	15	8·0	60	Hong Kong.
76·9	..	83	..	5·83	148	– 18	12	..	..	Sandakan.
50·1	26	72	4·3	10·82	275	+ 152	16	5·7	56	Sydney.
47·7	30	78	6·0	2·66	68	+ 22	11	..	..	Melbourne.
47·8	25	76	6·0	4·22	107	+ 40	17	4·4	44	Adelaide.
50·0	30	71	5·8	7·41	188	+ 22	18	5·0	49	Perth, W. Australia.
45·7	26	62	5·2	1·37	35	+ 12	9	..	..	Coolgardie.
53·9	34	69	3·5	4·68	119	+ 63	8	..	..	Brisbane.
44·7	28	82	6·0	6·02	153	+ 99	15	5·1	55	Hobart, Tasmania.
..	19	78	6·0	1·69	43	– 101	12	3·9	41	Wellington, N.Z.
69·1	..	76	6·5	3·79	96	– 21	15	..	..	Suva Fiji.
..	..	74	4·4	0·39	10	– 32	1	..	..	Kingston, Jamaica.
74·7	..	77	4·3	7·15	182	– 67	24	..	..	Grenada, W.I.
62·3	47	71	3·7	3·00	76	– 1	11	..	..	Toronto.
60·4	..	70	4·2	4·95	126	+ 49	9	..	..	Winnipeg.
56·9	44	86	6·9	4·07	103	+ 11	13	..	..	St. John, N.B.
53·7	43	80	2·1	Trace	Trace	– 9	1	..	..	Victoria. B.C.

* For Indian Stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

Colombo, Ceylon.—Prevailing wind direction WSW, mean speed 5·8 mi/hr.

Hong Kong.—Prevailing wind direction ESE, mean speed 11·6 mi/hr.; 8 days with thunder heard.

Sandakan.—Prevailing wind direction NE.

Perth, W. Australia.—Mean speed of wind 11·9 mi/hr.

Wellington, N.Z.—Prevailing wind direction variable, 3 days with fog.

Suva, Fiji.—Prevailing wind direction SE.

Grenada, W.I.—Prevailing wind direction E, 4 days with thunder heard.

										Mauritius :—
75·4	..	85	7·2	33·33	847	+ 650	26	4·9	37	January 1922.
75·0	..	82	6·0	7·37	187	– 26	24	8·4	66	February.
75·0	..	83	5·9	7·49	190	– 48	20	6·7	55	March.
68·5	51	74	4·6	5·56	141	+ 27	17	..	..	April.

(*Continued from p.* 345.)

off the Hebrides and moved slowly north-eastwards, being followed by yet another depression in the Atlantic. An exceptionally strong westerly wind gradient was prevalent over the Atlantic. In the early hours of the 29th the White Star liner *Baltic* reported a storm of force 11 in longitude 29° W.

This last depression crossed England on the 30th, and was situated over southern Scandinavia by the 31st, while a secondary depression moved along the south coasts of the British Isles. On the 29th a rainfall of 81 mm. occured at Lugano.

In northern Europe the weather throughout the month was of a very unsettled character, with frequent falls of snow and sleet. On the 11th, the trawler *Celeriña*, after a rough passage from Grimsby, was wrecked in a snowstorm off Vardo.

During the first part of the month a low pressure system over the central Mediterranean caused a period of unsettled weather in this area. On the 10th, 43 mm. of rain fell at Malta. About the middle of the month a high over the Western Mediterranean gave fair weather for a few days but afterwards a low, forming in a westerly current, persisted and gave unsettled weather for the remainder of the month.

W.C.K.

The month was cold and stormy on the Great Lakes; on the 18th it was reported that ice was already forming at the head of Lake Superior.

In Australia good rains were experienced, especially in central Queensland, where a good cotton crop is anticipated in consequence, and in many parts of New South Wales.

The special message from Brazil states that in the north rain was 45 mm. below the normal, while in the south, where atmospheric circulation was again very active, it was 54 mm. above normal. The rains in the centre were irregular. Temperature during the month was slightly above normal and pressure at Rio de Janeiro 1·8 mb. above normal. Thunderstorms were rare. The coffee and cotton crops are very promising, but in the south, wheat has suffered severely from rust.

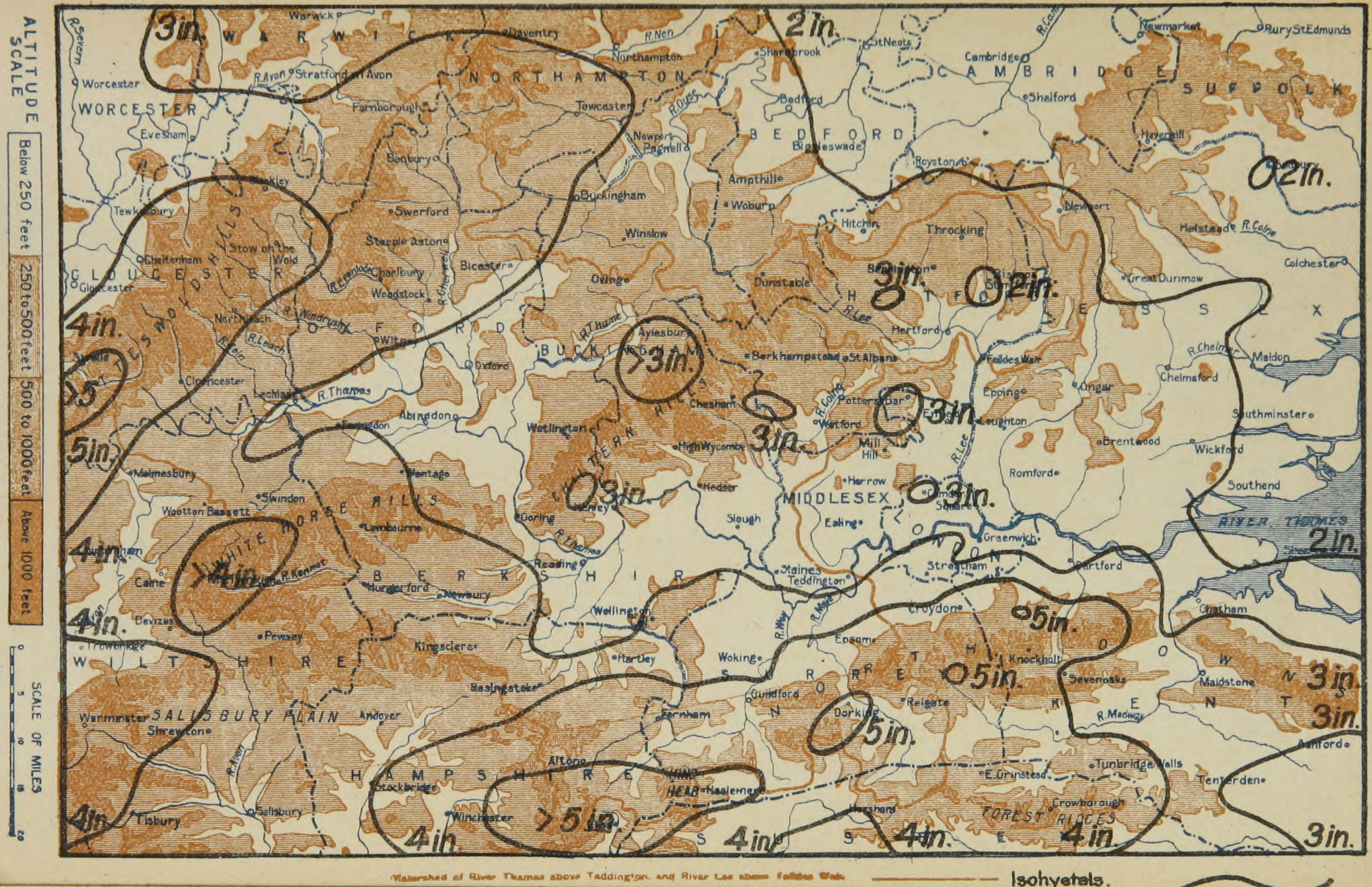
Rainfall in the British Isles.

THE general rainfall over the British Isles for December was practically normal. Almost the whole of England and Wales and Ireland had more than the average, while in Scotland there was a widespread but not very large deficiency. Departures of more than 50 per cent. from the average were rare and occurred chiefly in a wet patch in the centre of Yorkshire.

The general rainfall, expressed as a percentage of the average, was:—England and Wales, 122; Scotland, 86; Ireland, 102; British Isles, 106.

In London, Camden Square, the mean temperature for December was 43·4° F., or 3·3° F. above the average. Duration of rainfall, 57·0 hours. Evaporation, 0·14 inch.

THAMES VALLEY RAINFALL —— DECEMBER, 1922.


ALTITUDE SCALE
Below 250 feet
250 to 500 feet
500 to 1000 feet
Above 1000 feet
SCALE OF MILES
0
5
10
15
20
Watershed of River Thames above Teddington, and River Lee above Feildes Weir.
Isohyetals.
3in.
2in.
0·2in.
3in.
0·2in.
>3in.
3in.
0·3in.
0·3in.
0·3in.
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4in.
4in.
4in.
3in.
WARWICK
NORTHAMPTON
CAMBRIDGE
SUFFOLK
WORCESTER
BEDFORD
GLOUCESTER
OXFORD
BUCKINGHAM
HERTFORD
ESSEX
MIDDLESEX
LONDON
BERKSHIRE
WILTSHIRE
SURREY
KENT
HAMPSHIRE
SUSSEX
COTSWOLD HILLS
CHILTERN HILLS
WHITE HORSE HILLS
SALISBURY PLAIN
FOREST RIDGES
HIND HEAD
RIVER THAMES
R. Severn
R. Avon
R. Nen
R. Ouse
R. Cam
R. Colne
R. Chelmer
R. Windrush
R. Evenlode
R. Cherwell
R. Thame
R. Leach
R. Coln
R. Thames
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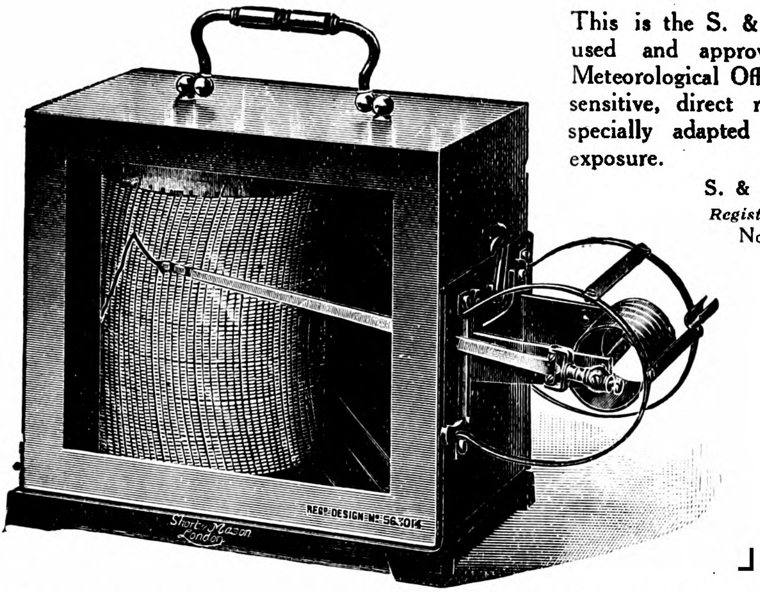

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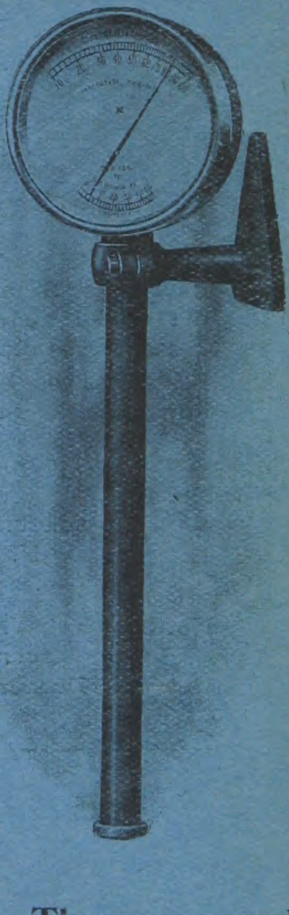

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